SUPPLEMENTAL BIBLIOGRAPHY ON INVESTMENT AND OPERATING COSTS FOR CHEMICAL AND PETROLEUM PLANTS

BY E. E. HARTON AND P. R. TISOT

* * * * * * * * * * **Information Circular 7705**

UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary
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J. J. Forbes, Director

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E. E. Harton[1/] and P. R. Tisot[2/]

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INTRODUCTION

Bureau of Mines Information Circular 7516, Bibliography of Investment and Operating Costs for Chemical and Petroleum Plants, was published in October 1949 as an aid in making estimates of investment and operating costs of processes for manufacturing synthetic liquid fuels. Development of such processes by the Bureau of Mines was authorized by Public Law 290, 78th Congress. This bibliography included references to and abstracts of publications appearing from 1930 to September 1948 on all processes in general use in the petroleum refining and chemical industries.

Publications in this field have been numerous since compilation of the above bibliography, and the present report was prepared to cover the field from September 1948 through June 1952.3/

The information contained in this paper was obtained from the following sources:

1. Bureau of Mines Information Circulars.
2. Bureau of Mines Report of Investigations.
3. Bureau of Mines Technical Papers.
4. Chemical Abstracts.
5. Chemical and Engineering News.
6. Chemical Engineering.
7. Chemical Engineering Cost Estimation, Aries, R. S. and Newton, R. D., Chemonomics, Inc., New York, N. Y., September 1950.
8. Chemical Engineering Costs, Zimmerman, O. T., and Lavine, I., Industrial Research Service, Dover, N. H., 1950.
9. Chemical Engineering Costs Quarterly (formerly Chemical Engineering Costs Supplement).
10. Chemical Engineering Progress.
11. Chemical Week (formerly Chemical Industries Week and before this Chemical Industries).
12. Coal Hydrogenation Plants, Ebasco Services, Inc., New York, N. Y., March 1952.
13. Industrial and Engineering Chemistry.
14. Industrial Arts Index.

3/ Only articles containing domestic cost information have been included in this survey.

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15. Journal of Petroleum Technology (formerly Petroleum Technology).

16. Library Bulletin of Abstracts.

17. Mines Magazine, The Colorado School of Mines.

18. Oil and Gas Journal, The.

19. Petroleum Engineer.

20. Petroleum Processing.

21. Petroleum Refiner.

22. Petroleum Refinery Engineering, Nelson, W. L., McGraw-Hill Book Co., Inc., New York, N. Y., 3d ed., 1949.

23. Synthetic Fuels Production Costs, National Petroleum Council Committee Report, Washington, D. C., Oct. 15, 1951.

24. World Oil.

No attempt was made to include every news item. This type of information appeared in several of the publications under such headings as Industrial News, New Construction, News of the Month, What's Happening, Refinery and Other Plant Construction, Pipelines Construction, Headlines, Refining News, Refining and Gas Processing News, and others.

ACKNOWLEDGMENTS

The work on this report was done under a cooperative agreement between the University of Wyoming and the U. S. Department of the Interior, Bureau of Mines.

ABSTRACTS

1. ALBRIGHT, J. C. Sulfur From California Hydrogen Sulfide. Petrol. Eng., vol. 21, No. 9, August 1949, pp. C7-10.

Cost of a plant producing 50 long tons of sulfur daily from hydrogen sulfide set at $1,250,000.

2. ALFRED, J. K. Developments in Internal Pipe-Coating. World Oil, vol. 132, No. 1, January 1951, pp. 181-4, 186, 190.

Costs and methods for treating pipe to prevent corrosion. Types of treatment include (1) plastic lining applied in place, (2) cement lining applied in the mill or local plant, and (3) cement lining applied in place.

3. _____. Internal Pipe-Coating Techniques. Oil Gas Jour., vol. 49, No. 28, Nov. 16, 1950, pp. 266, 268, 272-4.

Includes essentially the same information as references 2 and 4.

4. _____. Internal Pipe-Coating Techniques. Petrol. Eng., vol. 23, No. 1, January 1951, pp. D26, 28-34.

Includes essentially the same information as references 2 and 3.

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5. ALLEN, J. G., LITTLE, D. M., and WADILL, P. M. Visbreaking High-Vacuum Residuum. Oil Gas Jour., vol. 50, No. 6, June 14, 1951, pp. 78-84.

Describes pilot-plant and commercial-scale operations for visbreaking of high-vacuum residuum in a new design radiant heater. Direct manufacturing expenses:

Visbreaking, per bbl.	$0.10
Catalytic cracking, per bbl. .	.15
Treating, per bbl.	.03
T.E.L., per cc.	.0022

6. ANDERSON, T. H., and COLBURN, W. E. Liquid Recovery From Hydrocarbon Gases. Petrol. Eng., vol. 24, No. 6, June 1952, pp. C28, 31-2, 34-5.

Compares three methods for liquid recovery from hydrocarbon gases and investment cost for comparable size plants.

Absorption.....	$3,750,000
Condensate fractionation...	3,500,000
Gas fractionation.....	3,500,000

7. ARIES, R. S., and NEWTON, R. D. Chemical Engineering Cost Estimation. Chemonomics, Inc., 400 Madison Avenue, New York 17, N. Y., September 1950, 109 pp.

Lists installed costs of chemical plant equipment in tabular and graphic form. Each major equipment item is further subdivided into individual types. All costs stated are for delivered installed equipment. Also includes the cost of buildings; short cut methods for cost estimation; average life of equipment; taxes; payout time; cost data for manufacturing, labor, utilities, and fuel.

8. ARIES, R. S., and OTHMER, D. F. Methods of Determining Plant Location. Chem. Eng. Prog., vol. 45, No. 5, May 1949, pp. 285-8.

Percentage breakdown of cost bill. Lists factors to be considered in determining investment costs with respect to engineering, real estate, plant, and facilities; and operating costs with respect to transportation, manufacturing, maintenance, and overhead. Gives a detailed cost analysis of four proposed locations for a fertilizer plant based on the aforementioned factors.

9. AYERS, EUGENE, MONTGOMERY, C. W., and HIRSCH, J. H. Problems Associated with Fischer-Tropsch Process. Petrol. Eng., vol. 20, No. 3, December 1948, pp. 203, 206, 208, 210.

Cost of tonnage oxygen estimated about $0.15 per 1,000 cu. ft., or equivalent to $1.25 per barrel ($0.03 per gallon) of synthetic motor fuel.

10. AYRES, EUGENE. Petrochemicals: The Field with the Future. The Oil Forum, vol. 5, No. 5, May 1951, pp. 159-60, 163.

Discussion of chemicals from petroleum. Includes cost of manufacturing ethylene by cracking propane.

11. BARR, J. A. H_2SO_4, Buy or Build? Chamber or Contact? Chem. Eng., vol. 57, No. 4, April 1950, pp. 106-9.

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Economic discussion of the merits of buying sulfuric acid versus building a sulfuric acid plant. The costs of producing acid by the contact and Mills-Packard chamber methods are compared.

12. BATTELLE MEMORIAL INSTITUTE and FOSTER, J. F., and LUND, R. J. (Editors for Bituminous Coal Research, Inc.) Economics of Fuel Gas from Coal. McGraw-Hill Book Co., Inc., 330 West 42 St., New York 18, N. Y., 1950, 289 pp.

Evaluates the technical and economic aspects of producing fuel gas from coal. Discusses production of fuels from petroleum, natural gas, and atomic energy. Investment and operating costs included.

13. BAYARD, R. A. Pick Off Economic Insulation Thickness. Chem. Eng., vol. 57, No. 6, June 1950, pp. 142-4.

Presents a quick simple procedure for determining the economic thickness of insulation for flat or curved surfaces, either singly or in combination.

14. BEAN, T. W. Estimating Construction Costs in Chemical Process Industries. Ind. Eng. Chem., vol. 43, No. 10, October 1951, pp. 2302-4.

Reviews the necessary steps in preparing preliminary estimates and the more detailed steps required for a complete estimate based on advanced design information. The author points out that rarely can two jobs be estimated by identical methods.

15. BECHTELL, V. R. Inflation in Production and Operating Costs. Ind. Eng. Chem., vol. 43, No. 10, October 1951, pp. 2307-9.

Attempts to guide the prospective manufacturer by pointing out the factors involved in addition to the initial investment in order to survive amidst inflation and high taxes. On a unit basis with 1940 at par or 100, the comparisons provided are:

	1940	1948
Raw materials costs.....	100	190
Labor costs.....	100	210
Cost of new plants.....	100	250
Sales price.....	100	170
Net profits.....	100	110

16. BEESON, H. H. Financial Significance of Fractional Analysis. Oil Gas Jour., vol. 49, No. 50, Apr. 19, 1951, pp. 172, 222-3.

Significance of fractional analysis of gas with respect to plant investment and operating costs.

17. BELL, R. E., and WAGGAMAN, W. H. Western Phosphates Potential Markets. Ind. Eng. Chem., vol. 42, No. 2, February 1950, pp. 286-92.

An economic discussion of the possibility of expanding western phosphate production to compete in Midwest markets against production from the eastern United States.

18. BERG, CLYDE. Oil Shale as a Fuel Resource. Petrol. Eng., vol. 24, No. 1, January 1952, pp. A37-43.

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Various aspects of mining and retorting oil shale and refining shale oil. Comparison of estimated investment and operating costs for producing gasoline from shale oil shown for 1948, 1949, and 1951; the 1951 figure also includes gasoline from coal hydrogenation.

19. BLAND, W. F. Platforming-Operating Results and Design Details of First Commercial Installation of This New Catalytic Reforming Process for Upgrading Straight-Runs. Petrol. Proc., vol. 5, No. 4, April 1950, pp. 351-5.

Capital and operating costs for platforming units and performance data from Old Dutch Refinery platforming unit.

20. BLOHM, C. L. Processing Sulfur Bearing Gases. Petrol. Eng., vol. 24, No. 4, April 1952, pp. C68-72, 74.

Adaption in the United States of the Claus-Chance process, for converting hydrogen sulfide into sulfur and water, to the recovery of sulfur from sour gases. Gas-heating process, sulfur-recovery process, and related economics described. Graphs show plant production capacity in long tons per day plotted against (1) plant cost and (2) operating cost in dollars per ton of sulfur.

21. BLOHM, C. L., and CHAPIN, W. F. Purification and Dehydration of Gases. Oil Gas Jour., vol. 47, No. 29, Nov. 18, 1948, pp. 75, 77, 81-2, 85.

Describes the glycol-amine gas-treating process. Investment cost for a plant processing 50 million std. cu. ft. per day of natural gas containing 2 percent total acid gas listed as $300,000. Operating cost equal to 2 mills per 1,000 std. cu. ft. of gas processed.

22. BOHMFALK, J. F. Synthetic Rubber. Chem. Eng. News., vol. 28, No. 30, July 24, 1950, pp. 2504-9.

Investment and operating costs for butadiene, styrene, and GR-S production.

23. BOWEN, H. J. Why Make a Model? Chem. Eng., vol. 56, No. 8, August 1949, pp. 98-9.

Merits and costs of producing plant models.

24. BOYD, JAMES. Progress in Oil Shale Development and Research. Mines Mag. (Colo.), vol. 38, No. 12, December 1948, pp. 47-50.

General discussion of the Bureau of Mines synthetic fuels program. A table summarizes requirements, including investment costs for a 2-million-barrel-a-day synthetic liquid fuels industry.

25. BOYD, J. H. Should Chemicals Move by Pipeline. Chem. Ind., vol. 65, No. 3, September 1949, pp. 349,461.

Estimates cost to build and operate a 1,000-mile pipeline.

26. BROOKS, G. E. How to Estimate Plant Construction Costs. Part 1 - Fundamentals of Cost Estimation. Petrol. Eng., vol. 22, No. 3, March 1950, pp. C7-10; Part 2 - The Preliminary Estimate. Petrol. Eng., vol. 22, No. 4, April 1950, pp. C21-2, 24, 26-7; Part 3 - The Check Estimate. Petrol. Eng., vol. 22, No. 6, June 1950, pp. C31-2, 34-6.

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Series of three articles on cost estimation. Part 1 - Detailed outline of fundamentals of plant construction cost estimating, showing nature and types of facts needed for making such estimates. Part 2 - Discusses preliminary estimate and the routine of preparing it. Includes examples of cost estimate sheets and calculations involved. Part 3 - Detailed methods for arriving at more accurate and dependable cost estimates employing exact item cost figures, when available, and utilizing curves and graphs on various size, area, and other important physical data items.

27. BROOM, H. P. The Time Factor in Providing Plant and Equipment Needed to Produce a New Chemical May Upset the Best Estimates of Construction Costs. Chem. Eng. News, vol. 28, No. 14, Apr. 3, 1950, pp. 1109-11.

Graphs show prices of significant building materials and building construction prices and wages for 1939-49.

28. BROTHMAN, A., and RAMANI, R. V. Robotization of Process Plants. Chem. Eng., vol. 56, No. 11, November 1949, pp. 114-7, 124.

Discusses the use of pushbutton plants for cost reduction. Gives several actual case histories.

29. BROWN, C. O. Equipment and Design. Ind. Eng. Chem., vol. 42, No. 1, January 1950, pp. 59A-60A.

Design, cost, and efficiency of a Koch tower.

30. BUREAU OF MINES. Synthetic Liquid Fuels. Rept. of Investigations 4456, 1949, 62 pp.

Part 1 of the 1948 Annual Report of the Secretary of the Interior. Plant investment and manufacturing costs for coal hydrogenation.

31. _____. Synthetic Liquid Fuels. Rept. of Investigations 4457, 1949, 56 pp.

Part 2 of the 1948 Annual Report of the Secretary of the Interior. The included costs deal primarily with mining and crushing for shale preparation.

32. _____. Synthetic Liquid Fuels. Rept. of Investigations 4651, 1950, 62 pp.

Part 1 of the 1949 Annual Report of the Secretary of the Interior. Investment and operating costs for oil shale preparation and fuels from coal hydrogenation, petroleum residuum hydrogenation, and oil shale.

33. _____. Synthetic Liquid Fuels. Rept. of Investigations 4652, 1950, 70 pp.

Part 2 of the 1949 Annual Report of the Secretary of the Interior. Includes essentially the same cost information as references 32, 34, and 35.

34. _____. Synthetic Liquid Fuels. Rept. of Investigations 4653, 1950, 13 pp.

Part 3 of the 1949 Annual Report of the Secretary of the Interior. Includes essentially the same cost information as references 32, 33, and 35.

35. _____. Synthetic Liquid Fuels. Rept. of Investigations 4654, 1950, 26 pp.

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Part 4 of the 1949 Annual Report of the Secretary of the Interior. Includes essentially the same cost information as references 32, 33, and 34.

36. Bureau of Mines. Synthetic Liquid Fuels. Rept. of Investigations 4770, 1951, 74 pp.

Part 1 of the 1950 Annual Report of the Secretary of the Interior. Investment and operating costs for coal gasification by the pressure-dust and the Lurgi methods.

37. _____. Synthetic Liquid Fuels. Rept. of Investigations 4771, 1951, 88 pp.

Part 2 of the 1950 Annual Report of the Secretary of the Interior. Cost for preparing oil shale and estimated cost for producing and refining 11,700 barrels per day of shale oil by gas-combustion retorting, recycle cracking, and acid treating combination.

38. BURTIS, T. A., and NOLL, H. D. Houdriforming, Its Place in the Refining of Petroleum. Petrol. Eng., vol. 24, No. 6, June 1952, pp. C39, 40, 42-4.

Detailed data on economics of unit construction and process operation for several typical cases. Process equipment costs compared for crude unit, thermal cracker, thermal reformer, Houdriformer, and catalytic polymerization unit.

39. _____. Houdriforming's Role in Petroleum Refining. Oil Gas Jour., vol. 50, No. 51, Apr. 28, 1952, pp. 76-9.

Includes essentially the same information as reference 38.

40. BURTIS, T. A., DART, J. C., KIRKBRIDE, C. G., and PEAVY, C. C. Economics of Moving Bed Catalytic Cracking Processes. Chem. Eng. Prog., vol. 45, No. 2, February 1949, pp. 97-101.

An economic comparison between the moving bed T.C.C. and the Houdriflow moving bed catalytic cracking processes. The economic appraisal is based on investment, amortization, maintenance, utility,and catalyst costs.

41. BYRNE, T. J., and JENKINS, F. M. Maintenance of a Fluid Cat Cracking Unit - In a Medium-Size Refinery and Particularly During the Turnaround Period. Oil Gas Jour., vol. 48, No. 46, Mar. 23, 1950, pp. 275, 277-8, 280.

Description of maintenance procedures, including material and labor costs.

42. BYRNES, F. C. Ternary Diagram Simplifies Figuring Raw Material Costs. Chem. Eng., vol. 58, No. 3, March 1951, pp. 125-6.

Uses and application of the ternary diagram for figuring raw material costs. Example concerns blending fertilizer ingredients, however, the principle could be applicable in other processes.

43. CALDWELL, J. A. A New Inhibitor for Sulfide Corrosion. Petrol. Eng., vol. 23, No. 3, March 1951, pp. B58, 61-2.

Costs and effectiveness of a hydrogen sulfide corrosion inhibitor in flow lines, pumps, and related equipment.

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44. CALISE, V. J. Cooling Water Treatment. Petrol. Eng., vol. 21, No. 3, March 1949, pp. A56-8, 60.

Investment and operating cost comparison of three types of cooling water plants; (1) sludge-contact reactor plus acid, (2) sodium zeolite softening plus bypass plus acid, and (3) acid feed.

45. _____. Some Economic Factors in Waste Water Treatment. Chem. Eng. Prog., vol. 46, No. 7, July 1950, pp. 328-34.

Economic factors involved in selecting and operating treating plants for handling acid and plating wastes, white waters from pulp and paper mills, and oil-bearing wastes from petroleum refineries and manufacturing plants. Flow diagrams and sketches included.

46. CALISE, V. J., and LANE, MARVIN. Silica Removal by Practical Ion Exchange Process. Ind. Eng. Chem., vol. 41, No. 11, November 1949, pp. 2554-63.

Design and performance of a commercial installation for removing silica by direct ion exchange. Theory and operational cost and problems discussed.

47. CALLAHAM, J. R. How Virginia-Carolina Makes Phosphorus by Sound Engineering, One Unit Process, Four Unit Operations. Chem. Eng., vol. 58, No. 4, April 1951, pp. 102-6.

Cost reduction by employing sound engineering principles. Electrical energy is 30-35 percent of phosphorus production cost.

48. CHANDLER, W. E. Preventative Maintenance in the Chemical Industry. Chem. Eng. Prog., vol. 48, No. 4, April 1952, pp. 161-4.

Points out advantages of protective maintenance over general maintenance. Maintenance costs with respect to production, capital investment, and power consumption.

49. CHEMICAL ENGINEERING. Coal Hydrogenation - More Cost Data. Vol. 59, No. 6, June 1952, pp. 159-61.

Compares the Bureau of Mines, Ebasco, and National Petroleum Council cost estimates for coal hydrogenation to produce synthetic fuels.

50. _____. How Process Equipment Costs Varied. Vol. 59, No. 2, February 1952, p. 191.

Marshall and Stevens Indexes of comparative equipment costs. These are compiled quarterly for March, June, September, and December issues for each year. Indexes are for 47 different industries. The article by R. W Stevens, Chem. Eng., November 1947, pp. 124-6, explains the method of obtaining the index number. The present article lists annual averages since 1913.

51. _____. 14 Lobes Make a Big Sphere. Vol. 58, No. 12, December 1951, p. 220.

Cost of Horton multisphere storage tank, 105,000 gallon capacity, for methyl chloride approximately $80,000.

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52. CHEMICAL ENGINEERING. Methanol Today. Vol. 58, No. 6, June 1951, pp. 285-7.

Economic and production survey for methanol.

53. _____. Now a Low-Cost Atomic Furnace. Vol. 58, No. 12, December 1951, pp. 228, 230.

Practical, low-power, multipurpose research nuclear reactor unit for private industry and research institutions available for approximately $1,000,000.

54. _____. Process Power Requirements. Vol. 58, No. 3, March 1951, p. 115.

Chart gives consumption of electricity in manufacture of over 100 chemical products.

55. _____. Estimating Requirements for Process Steam and Process Water. Vol. 58, No. 4, April 1951, pp. 110-1.

Chart gives steam in pounds per pound of product and water in gallons per pound of product for the manufacture of approximately 80 different chemicals and products.

56. _____. Ultrasonics in Processing. Vol. 58, No. 8, August 1951, pp. 200, 202.

Application of ultrasonics to industrial processing. Pilot-size transducer costs less than $10,000.

57. _____. What Price Process Plants? Vol. 58, No. 5, May 1951, pp. 164-5.

Plant costs in dollars per annual ton of capacity given in charts for 135 different chemical plants.

58. _____. What Price Tonnage Oxygen? Vol. 58, No. 7, July 1951, pp. 186, 188.

Plant capital, production, and use cost for tonnage oxygen by the Linde-Fraenkl method.

59. CHEMICAL ENGINEERING NEWS. Acetylene. Vol. 28, No. 49, Dec. 4, 1950, pp. 4244-7.

Investment and processing cost for calcium carbide manufacture included in a comparison of investment costs of acetylene production from petroleum and carbide.

60. _____. Bituminous Coal Moves to Halt Inroads of Oil and Gas. Vol. 30, No. 10, March 10, 1952, p. 990.

Fuel costs for coal-fired gas turbine are stated to be cheaper than for diesel engines of the same power.

61. _____. Chlorine. Vol. 29, No. 5, Jan. 29, 1951, pp. 364-9.

Investment and manufacturing cost for producing chlorine by the diaphragm-cell and mercury-cell processes.

62. _____. Cost of Synthetic Fuels. Vol. 28, No. 15, Apr. 10, 1950, pp. 1187-9.

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Capital investment and operating costs for a 10,000-barrel-per-day shale-oil plant and a 30,000-barrel-per-day coal-hydrogenation plant. Operating costs for producing 14,035 tons per day of crushed oil shale.

63. CHEMICAL ENGINEERING NEWS. Ebasco Confirms Bureau of Mines' Estimates of Gasoline from Coal. Vol. 30, No. 17, Apr. 28, 1952, pp. 1739-40, 1742.

Discussion of Ebasco report on costs of gasoline production from coal hydrogenation. The Ebasco, Bureau of Mines, and National Petroleum Council reports are compared.

64. CHEMICAL INDUSTRIES. Case for Crude. Vol. 65, No. 5, November 1949, pp. 706-7.

Investment and producing costs per daily barrel of equivalent gasoline:

Raw material	Investment	Cost
Wyoming crude.....	$ 9,500	2.09/bbl.
Gulf Coast natural gas..	6,200	0.12/M c.f.
Colorado oil shale.....	11,700	0.99/ton
Ind. bituminous coal....	13,900	3.03/ton
Mont. subbituminous coal	18,200	1.83/ton

65. CHEMICAL INDUSTRY WEEKLY. More Chlorine - And Soon. Vol. 68, No. 12, Apr. 7, 1951, pp. 9-10.

Brief figures on investment costs for a chlorine plant.

66. CHESTER, S., and JESSER, B. W. How to Figure Costs for Closed Relief-Valve Discharge Systems. Oil Gas Jour., vol. 51, No. 2, May 19, 1952, p. 161.

Formulas for determining proper design of equipment for use in cost determinations.

67. _____. Cost Comparison - When Setting Relief Valve Below Vessel Design Pressure. Oil Gas Jour., vol. 51, No. 3, May 26, 1952, p. 223.

Costs concerned with relief valves on gas flare installations.

68. _____. Cost Comparison - When Using Back-Pressure Refief Valves. Oil Gas Jour., vol. 51, No. 4, June 2, 1952, p. 115.

Costs associated with flare system using back-pressure Relief valves.

69. CHILTON, C. H. Cost Data Correlated, Chem. Eng., vol. 56, No. 6, June 1949, pp. 97-106.

Discussion and numerous graphs for estimating equipment costs, including factors for converting costs to total-plant cost. Among these items are pressure tanks; liquid pumps; cyclone separators; gas holders; towers; evaporators; storage tanks; demineralized water systems; electric motors; motoreducers; size-reduction equipment; centrifugals; driers and kilns; heat exchangers; continuous thickeners; cross-country pipelines; gas producers; spray driers; fans, blowers, and compressors; refrigeration units; liquid filters; furnaces; and agitated vessels.

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70. CHILTON, C. H. Cost Estimating Simplified. Chem. Eng., vol. 58, No. 6, June 1951, pp. 108-11.

Methods for estimating investment and manufacturing costs for products in any stage of development. Estimation of indirect costs, working capital, and return on investment is explained. Simplified equation for selling price is given, and numerical relationships between factors involved in manufacturing are included.

71. _____. Process Labor Requirements. Chem. Eng., vol. 58, No. 2, February 1951, p. 151.

Chart for predicting process labor requirements in determining operating costs for over 50 chemical products and processes.

72. _____. "Six Tenth Factor" Applies to Complete Plant Costs. Chem. Eng., vol. 57, No. 4, April 1950, pp. 112-4.

Graphs enable estimation of expansion costs for 36 product and process plants. Doubling the size of a plant costs approximately 20.6 times the cost of the original plant.

73. CLARK, ALFRED, and LANNING, W. C. Residuum Hydrogenolysis vs. Coal Hydrogenation. Oil Gas Jour., vol. 50, No. 44, Mar. 10, 1952, pp. 90-2, 120.

Comparison of operating and cost data for residuum hydrogenolysis and coal hydrogenation.

74. CLARKE, LOYAL. Cost Estimates Answer Questions. Chem. Eng., vol. 58, No. 12, December 1951, pp. 144-5, 150.

Several examples of how cost estimates are used at various stages of a project.

75. COBURN, S. E. Treatment of Cotton Printing and Finishing Wastes. Ind. Eng. Chem., vol. 42, No. 4, April 1950, pp. 621-5.

Compares the construction costs and operation charges of a chemical treating plant with those of a high-rate trickling filter plant for treating cotton printing and finishing wastes.

76. COFIELD, E. P., Jr. Solvent Extraction of Oilseed. Chem. Eng., vol. 58, No. 1, January 1951, pp. 127-40.

A comprehensive discussion of solvent extraction, including economic aspects and cost of extraction plants.

77. COLQUETTE, R. T., and PETERS, CARL. Increase Earnings Through Coking of Residual. Petrol. Refiner, vol. 31, No. 4, April 1952, pp. 160-2.

Development of the economics of increasing gasoline production by converting No. 6 Fuel via coking and cracking and by refining additional crude via topping and cracking. Discusses economics of fuel production versus coke production.

78. _____. To Coke or Not to Coke Residual Petroleum Products - Here's the Economics. Oil Gas Jour., vol. 50, No. 49, Apr. 14, 1952, pp. 156, 160, 162, 174.

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Includes essentially the same information as reference 77.

79. COMSTOCK, C. S. How Good Instrumentation Can Save Dollars, Part 1. Chem. Ind., vol. 63, No. 6, December 1948, pp. 950-2.

Cost of instruments and instrument repairs, maintenance and operation.

80. CONSIDINE, D. M. Petroleum Refinery Instrumentation. Part 1, Petrol. Eng., vol. 22, No. 10, September 1950, pp. C22, 24-6; part 2, Petrol. Eng., vol. 22, No. 11, October 1950, pp. C24, 26, 29, 30, 32; part 3, Petrol. Eng., vol. 22, No. 12, November 1950, pp. C42, 44-6.

Series of three articles concerned with the economics of the use of instruments and their role in refining operations and in pilot plants:

Part 1 - Case histories of refinery instrumentation. Representative instrument investment costs expressed as percentages of total capital equipment costs stated as 3 percent for solvent dewaxing plant, 4 percent for styrene and ethylene plants, 3.4 percent for T.C.C. units, 4.9 percent for gas-recovery units, 1.5 percent for average textile process, and 2 percent for average chemical process.

Part 2 - No actual cost figures listed.

Part 3 - Cost comparison of graphic control panels with conventional control panels. Fluid catalytic cracking project for example:

Cost of conventional panel	$14,562
Cost of color-graphic panel	20,029 (37% over conventional)
Cost of graphic panel	24,173 (40% over conventional)

81. CUBBERLY, ROBERT. Waste Heat Recovery Has Almost Limitless Possibilities. Chem. Eng., vol. 57, No. 5, May 1950, pp. 140-5.

Describes waste heat boilers for several chemical industries and tells how to determine the heat available. Economics include savings, returns, and installation costs.

82. D'ARCY, N. A., Jr. Flotation Processes. Chem. Eng., vol. 58, No. 6, June 1951, pp. 252, 254-5.

The economics of industrial waste disposal by the flotation process.

83. DAVIS, W. H., HARPER, J. I., and WEATHERLY, E. R. The Arosorb Process - A New Refining Tool. Oil Gas Jour., vol. 51, No. 2, May 19, 1952, pp. 112-4, 116, 119-20.

Description of the Arosorb process. Operating costs detailed for processing kerosine, catalytic reformate, and catalytic gas oil. Operating costs are 1 to 3 cents per gallon of charge. Investment costs for plants of 500 to 5,000 barrel capacity per day are, respectively, $750,000 to $2,250,000.

84. _____. The Arosorb Process in Refinery Operations. Petrol. Eng., vol. 24, No. 6, June 1952, pp. C5-8.

Includes essentially the same information as references 83 and 85.

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85. DAVIS, W. H., HARPER, J. I., and WEATHERLY, E. R. The Arosorb Process in Refinery operations. Petrol. Refiner, vol. 31, No. 5, May 1952, pp. 109-13.

Includes essentially the same information as references 83 and 84.

86. DECKER, W. H. Economics of Power Generation at Sinclair's East Chicago Refinery. Oil Gas Jour., vol. 58, No. 46, Mar. 23, 1950, pp. 232, 235-6, 238, 345-6.

Points out the savings realized by generating power instead of purchasing it. Graph shows amortization period (years) versus fuel oil price (dollars per barrel).

87. DEGLER, H. E. Selection, Operation, and Maintenance of Cooling Towers and Air-Cooled Exchangers. Oil Gas Jour., vol. 50, No. 18, Sept. 6, 1951, pp. 76-8, 80.

Comparison of investment and operating costs for cooling towers and air-cooled exchangers.

88. _____. Selection and Operation of Water-Cooling Towers and Air-Cooled Heat Exchangers. Petrol. Refiner, vol. 30, No. 11, November 1951, pp. 145-50.

Includes essentially the same cost information as reference 87, except the former contains a table on the characteristics and costs of water-cooling towers, which is not included in the present article.

89. DICKINSON, W. H. Power Wiring in Petroleum Refineries. Oil Gas Jour., vol. 47, No. 47, Mar. 24, 1949, pp. 287-95.

Cost comparison of three single-conductor cables, comparison of radio feeder costs, and comparative installed costs of power wiring.

90. DICKSON, R. A. Labor Cost of Installing Piping. Chem. Eng., vol. 56, No. 4, April 1949, pp. 97-8.

Formulas and graphs for estimating labor costs of installing piping.

91. _____. Pipe Cost Estimation, Chem. Eng., vol. 57, No. 1, January 1950, pp. 123-35.

Compilation of graphs and factors for accurately estimating costs of pipe, namely: Aluminum; brass; duriron; durichlor; glass; lead; porcelain; steel, stainless; steel, lead-lined; steel, rubber-lined; and steel, saran-lined of various grades.

92. DOUGHERTY, W. F. Repair and Maintenance of Cat Cracking Equipment. Petrol. Eng., vol. 22, No. 5, May 1950, pp. C33-4, 36.

Detailed discussion of the maintenance program for a T.C.C. unit. Program consists of normal maintenance and maintenance required during a turnaround. Material and man-hour costs per month included.

93. DRAUGHON, C. R., Jr., and McNEIL, E. B. Design of Cathodic Protection for Open-Box Type Coolers. Petrol. Refiner, vol. 29, No. 5, May 1950, pp. 97-103.

Cathodic protection reduces maintenance costs by controlling corrosion on water-side of open-box-type coil coolers. Saving and unit-operating and investment costs discussed.

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94. DRESSER, HAROLD. Water Cooling Equipment. Petrol. Eng., vol. 23, No. 8, Reference Annual 1951, pp. C27, 30, 32-4.

Gives water-loss costs for water-cooling towers.

95. DUNN, C. L., and LIEDHOLM, G. E. Extractive Distillation of High-Purity Aromatics. Oil Gas Jour., vol. 51, No. 5, June 9, 1952, pp. 68-70, 96.

Brief mention of operating costs together with processing data.

96. DYBDAL, E. C. Engineering and Economic Evaluation of Projects. Chem. Eng. Prog., vol. 46, No. 2, February 1950, pp. 57-66.

Points out the merits of economic evaluation at an early stage of the research program to eliminate economically unsound or impractical projects. The techniques involved in the following phases are discussed in detail: Analysis of laboratory projects from economic standpoint; preparation of preliminary production cost estimates; analysis of laboratory projects from engineering standpoint; interpretation of manufacturing cost estimate; estimation of capital requirements; selling price and return on capital investment; report on engineering and economic evaluations; and short cuts in estimating.

97. EBASCO SERVICES, INC. Coal Hydrogenation Plants. Ebasco Services, Inc., 2 Rector Street, New York, N. Y , March 1952, 180 pp.

Reviews certain elements of the Bureau of Mines cost estimate for synthetic liquid fuels from coal hydrogenation.

98. ELLIOTT, V. L. New Type Forms Provide Closer Control of Refining Costs. Petrol. Proc., vol. 7, No. 1, January 1952, pp. 62-4.

Cost accounting forms and their use.

99. ESKEW, R. K., MacPHERSON PHILLIPS, G. W., HOMILLER, R. P., REDFIELD, C. S., and DAVIS, R. A. Frozen Concentrated Apple Juice. Ind. Eng. Chem., vol. 43, No. 10, October 1951, pp. 2397-2403.

Flow diagram and operating conditions given. Cost sheet and equipment cost lists for plants producing 417 and 1,500 gallons of juice per hour.

100. FAGLEY, W. L., and BLUM, G. W. Calculate Payout Time for Your Investment. Chem. Eng., vol. 57, No. 7, July 1950, pp. 116-8.

A new empirical method for calculating time necessary to pay off a capital investment. Compares the Fagley-Blum method with the simplified method and log method of Buell.

101. FERENCZ, PAUL. Statistical Analysis of Cost Estimates. Chem. Eng. News, vol. 29, No. 41, Oct. 8, 1951, pp. 4158-60.

Application of statistical analysis in obtaining more accurate information from cost estimates.

102. _____. Statistics Can Put More Meaning Into Your Cost Estimates. Chem. Eng., vol. 59, No. 4, April 1952, pp. 143-7.

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Discusses statistics and statistical analysis in relation to cost estimation and illustrates these points with examples.

103. FEUCHTER, C. F. Economics of Thermal Reforming. Chem. Eng. Prog., vol. 45, No. 10, October 1949, pp. 644-8.

Economics for determining the optimum reforming level for a hypothetical refinery processing 20,000 barrels per day of East Texas crude. The out-of-pocket operating cost of the thermal reforming unit is the sum of a fixed charge of $250 per day for the cost of process labor; maintenance and repairs; and an incremental cost of $0.05 per barrel of naphtha reformed for the cost of fuel, water, steam, electricity, and chemicals; and an incremental polymerization unit cost of $0.50 per barrel of polymer produced. Illustrates effects of product prices, T.E.L. cost, and octane number specifications upon the economics of thermal reforming.

104. _____. Economics of Thermal Reforming. Oil Gas Jour., vol. 48, No. 11, July 21, 1949, pp. 62, 64, 69, 94, 96.

Includes essentially the same information as reference 103.

105. _____. Thermal Reforming Economics (abstract of a paper). Petrol. Proc., vol. 4, No. 6, June 1949, pp. 682, 684, 686.

A brief comment on operating costs included in a discussion of a hypothetical refinery processing 20,000 barrels per day of East Texas crude oil.

106. FIELDNER, A. C., and GOTTLEY, SIDNEY. Annual Report of Research and Technologic Work on Coal, Fiscal Year 1950. Bureau of Mines Inf. Circ. 7618, 1951, 80 pp.

Includes cost estimate for 30,000-barrel-per-day coal-hydrogenation plant.

107. FISHER, A. W., Jr., and BOWEN, R. J. Performance of Stainless Steel McMahon Packing. Chem. Eng. Prog., vol. 45, No. 6, June 1949, pp. 359-69.

Comparison of performance of McMahon stainless steel and brass packing with ceramic Berl saddles. Gives approximate cost per theoretical plate for the various types of packing.

108. FISHER, H. E. Design of Large-Capacity Dehydration Plants for Products Pipe Line. Oil Gas Jour., vol. 48, No. 22, Oct. 6, 1949, pp. 229-30, 232, 235-6, 239.

Comparison of the investment and operating expenses for the steam, gas, and naphtha methods for dessicant regeneration in a 50,000-barrel-per-day dehydration plant.

109. FOSTER, A. L. Can Private Business Compete with Government? Petrol. Eng., vol. 24, No. 5, May 1952, pp. C3-4.

General discussion of effects of taxes and government endeavors on the petroleum industry. Actual costs mentioned pertain to the coking and catalytic reforming processes.

110. _____. Chemists Survey Oil Refining Technology. Petrol. Eng., vol. 23, No. 11, October 1951, pp. C3-4.

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Brief comment on operating costs for fluid hydroforming.

111. FOSTER, A. L. More Catalysis - Refining's Watchword. Petrol. Eng., vol. 24, No. 4, April 1952, pp. C3-6.

The economics reported for the fluid hydroforming process, for a 7,500-barrel-per-day charge capacity yielding 6,800 barrels per day of product, shows credits of $36,000 against $30,000 cost per day before depreciation, a margin slightly greater than $6,000 per day for a payout time of 1 year. Briefly mentions costs of producing gasoline by coal hydrogenation.

112. _____. New Platformer Improves Octane Rating. Petrol. Eng., vol. 24, No. 2, February 1952, pp. C39-40, 42.

Cost estimates for a new 1,500-barrel-of-charge-per-day unit range from $750,000 to $900,000.

113. _____. New Refinery Specializes in Sour Crudes. Petrol. Eng., vol. 21, No. 12, November 1949, pp. C6-10, 12.

Cost of complete new Continental Oil Co. refinery at Billings, Mont., completed in 1949 was approximately $9,500,000. Refinery includes atmospheric distillation, catalytic desulfurization, treating operations, catalytic cracking, propane deasphalting, catalytic polymerization, fractionation, and other typical refining operations.

114. FOSTER, A. L., and REFINERY STAFF (Socony-Vacuum Oil Co., Inc., Trenton, Mich.). Desalting Crude Oil. Petrol. Eng., vol. 23, No. 9, August 1951, pp. C34-8.

Construction costs are between $6 and $10 per daily barrel capacity; operating costs vary from over $3 to a little more than $4 per 1,000 barrels treated. Breakdown of operating costs. Completely installed, 50,000-barrel-per-day plant costs approximately $300,000.

115. FOWLE, M. J., BENT, R. D., MILNER, B. E., and MASOLOGITES, G. P. In Reforming It's the Catalyst That Counts. Petrol. Refiner, vol. 31, No. 4, April 1952, pp. 156-9.

Description of Atlantic Refining Co.'s catalytic-reforming-process operations. Investment costs range from $350 to $450 per barrel of naphtha charge for plants with a 750- to 12,000-barrel-per-day charge capacity.

116. _____. It's the Catalyst That Counts. Petrol. Eng., vol. 24, No. 5, May 1952, pp. C40, 42-4.

Includes essentially the same information as reference 115.

117. FOX, J. L. Operating Alternatives on Basis of Cost Analysis. Petrol. Refiner, vol. 29, No. 7, July 1950, pp. 90-4.

Works out five cost estimating problems to illustrate the value of considering alternate courses of action. Examples given are as follows: Whether to sell or process fuel oil further; price to pay for an intermediate stock; to treat kerosine for sale or to use it as cracking stock; proposed construction of additional capacity; and shutdown considerations.

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118. FRUECHTENICHT, H. L., and SIMPSON, J. B. Underground Storage of Propane-Air and Natural-Gas Mixtures. Oil Gas Jour., vol. 48, No. 4, June 2, 1949, pp. 70-2, 76-7.

Costs for building and operating a plant for storing propane-air and natural-gas mixtures underground.

119. _____. Underground Storage of Propane-Air and Natural-Gas Mixture. Petrol. Eng., vol. 21, No. 6, June 1949, pp. D11-4, 16.

Includes essentially the same information as reference 118.

120. FULTON, W. F. Platforming Natural Gasoline - Its Potentialities for the Industry. Petrol. Refiner, vol. 29, No. 12, December 1950, pp. 109-12.

Brief explanation of uses and limitations of several processes suitable for upgrading natural gasoline. Emphasis placed on platforming and includes chemistry, operating data, and economics.

121. GALL, J. T. Properly Designed Thermal Insulation Can Earn Big Investment Returns. Petrol. Refiner, vol. 31, No. 5, May 1952, pp. 165-8.

Explains how to properly insulate for maximum return on investment.

122. GARDNER, F. T., CLOTHIER, A. T., and CORYELL, F. Use of Ammonia in Control of Vapor-Zone Corrosion in Storage Tanks. Oil Gas Jour., vol. 48, No. 27, Nov. 10, 1949, pp. 238, 241-2, 245-6.

Results of several years study of effects of ammonia on reduction of hydrogen sulfide corrosion in crude storage tanks, including economics in terms of dollars saved per year per tank and cost of installation of facilities per barrel of crude.

123. GIBBS, R. G. New Legislation Needed to Establish Synthetic Liquid Fuel Industry - Petroleum Consumption to Exceed Domestic Production. Chem. Eng. News, vol. 26, No. 52, Dec. 27, 1948, p. 3809.

Comparative investment costs per barrel day given as:

1.	New petroleum capacity	$5,000-6,000
2.	Direct hydrogenation of coal	9,000
3.	Gas synthesis or modified Fischer-Tropsch process using coal	8,000
4.	Natural gas	5,300
5.	Shale oil	3,100

124. GREGORY, L. S. "Packaged" Gasoline Plant Completely Portable. Oil Gas Jour., vol. 49, No. 30, Nov. 30, 1950, pp. 60-2, 72.

Brief mention of replacement and operating costs for small portable plant.

125. GRIFFIN, E. L., Jr., WILLARD, M. J., Jr., SINNAMON, H. I., EDWARDS, P. W., and REDFIELD, C. S. Preparation of allylsucrose. Ind. Eng. Chem., vol. 43, No. 11, November 1951, pp. 2629-34.

Pilot investigation of preparation of allylsucrose monomer. Processing and equipment described in detail. Cost estimate included.

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126. GROVE, C. S., Jr., and CASEY, R. S. Deionized Water for Writing-Ink Manufacture. Chem. Eng. Prog., vol. 44, No. 10, October 1948, pp. 733-6.

Comparison of cost figures for the purification of water by demineralization and distillation. Installation and operating cost for an ion-exchange unit with an 80-gallon-per-hour throughput. Flow diagram and picture of unit included. Concludes that deionization is cheaper than distillation.

127. GUTHRIE, V. B. Aromatics by Adsorption. Petrol. Proc., vol. 6, No. 8, August 1951, pp. 833-5.

Operation and cost data for Arosorb process.

128. _____. Test Data Meager For Five Years of Synthetic Fuels Research. Petrol. Proc., vol. 5, No. 5, May 1950, pp. 505-8, 10.

Investment and operating costs estimated for 10,000-barrel-per-day shale-oil plant and a summary of the costs for a 16,500-barrel-per-day petroleum residual-hydrogenation plant.

129. _____. Bureau Whittles Down Cost Estimate for Coal Hydrogenation Plant. Petrol. Proc., vol. 7, No. 4, April 1952, pp. 413-4.

New estimate for cost of coal-hydrogenation plant of 15,000-barrel-per-day capacity is $174,500,000. Cost of hydrogen purification and compressor unit for the plant estimated at $17,100,000.

130. HAENSEL, VLADIMIR. Platforming. Petrol. Eng., vol. 22, No. 4, April 1950, pp. C9-12, 14.

Chemistry, operating variables, products produced, and operating costs related to platforming natural gasoline. Investment costs range from $700,000 for a 1,500-barrel-per-day stream charge, $1,600,000 for 5,000-barrel-per-day stream charge, and $2,500,000 for a 10,000 barrel-per-day stream charge. Operating costs range from $0.30 to $0.37 per barrel of charge for plants of 1,500- to 5,000-barrel-per-day capacity.

131. _____. Platforming. Petrol. Proc., vol. 5, No. 4, April 1950, pp. 356-60.

Includes essentially the same information as references 130, 132, and 133.

132. _____. Platforming. Petrol. Refiner, vol. 29, No. 4, April 1950, pp. 131-6.

Includes essentially the same information as references 130, 131, and 133.

133. _____. Platforming Approaches the Ideal Solution for Reforming Low-Octane and Straight-Run Gasolines. Oil Gas Jour., vol. 48, No. 47, Mar. 30, 1950, pp. 82-5, 114, 119.

Includes essentially the same information as references 130, 131, and 132.

134. HAPPEL, JOHN. New Approach to Payout Calculations. Chem. Eng., vol. 58, No. 10, October 1951, pp. 146-8.

Determination of payout calculations based on probability of success or of failure, effect of increased income tax rates, and future value of income and capital.

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135. HAPPEL, JOHN, and ARIES, R. S. Venture Probability in Economic Balances. Chem. Eng. Prog., vol. 46, No. 3, March 1950, pp. 115-20.

Equations and examples illustrate a technique for determining the conditions that permit maximum returns from manufacturing operations.

136. HAPPEL, JOHN, and MARSEL, CHARLES. Processes Compete in Acetylene Boom. Chem. Ind. Week, vol. 68, No. 15, Apr. 28, 1951, pp. 17-26.

Investment and operating costs for calcium carbide and acetylene from calcium carbide.

137. HATCHETT, V. W. Applications of Cathodic Protection to Control Refinery Corrosion. Oil Gas Jour., vol. 50, No. 45, Mar. 17, 1952, pp. 256, 258-9, 261-2, 264.

Several case histories including installation and maintenance costs.

138. HAYES, J. G., HAYS, L. A., and WOOD, H. S. Commercial Desalting Unit Employing Fiberglas as Contacting Agent. Chem. Eng. Prog., vol. 45, No. 4, April 1949, pp. 235-40.

Removal of inorganic salts from crude petroleum before refining. Fiberglas costs $0.0000965 per barrel of crude based on 378 operating days; $0.0000704 per barrel of crude based on 74 weeks.

139. HERTZ, D. B. Over-all Energy Savings Demand Cooling Water Economy. Chem. Eng., vol. 57, No. 5, May 1950, pp. 147-50.

Attempts to answer the questions: What data are needed to find the cheapest sources of water? When does a cooling tower become economical? When is air cooling economical?

140. _____. What Does Water Cost? Chem. Ind., vol. 66, No. 4, April 1950, pp. 512-4.

Building cost, operating cost for cooling towers, and treatment cost.

141. HICKS, T. G. Charts Presented to Aid Refinery Designers and Operators. Petrol. Refiner, vol. 30, No. 11, November 1951, pp. 134-8.

Chart V is a graph entitled "Estimating Operating Cost of Gas Engines."

142. HIGSON, G. I. $CaSO_4$ as a Raw Material for Chemical Manufacture. Chem. Eng. News, vol. 29, No. 43, Oct. 22, 1951, pp. 4469-74.

Process cost comparison for the production of ammonium sulfate by: Anhydrite process, saturator process, and byproduct (indirect); and for the production of sulfuric acid in a cement-sulfuric plant, sulfur-burning plant, and pyrites-burning plant.

143. HIRST, L. L., MARKOVITS, J. A., SKINNER, L. C., DOUGHERTY, R. W., and DONATH, E. E. Estimated Plant and Operating Costs for Producing Gasoline by Coal Hydrogenation. Bureau of Mines Rept. of Investigations 4564, 1949, 83 pp.

Detailed investment and operating costs for coal-hydrogenation plants.

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144. HIRST, L. L., SKINNER, L. C., CLARKE, E. A., DOUGHERTY, R. W., and LEVENE, H. D. Estimated Cost of Producing Heavy Fuel Oil by Hydrogenation of Coal. Bureau of Mines Rept. of Investigations 4413, 1948, 53 pp.

Cost estimate involving production of heavy fuel oil by hydrogenation of coal. Costs include: Paste preparation plant; hydrogenation stalls; plant for direct hydrogenation of gas from coal gasification and of gas from coke-oven gas; and extraction and hydrogenation of gas from coal gasification and of gas from coke-oven gas. Costs are broken down in detail.

145. HOLADAY, W. M. Advances in Petroleum Refining. Oil Gas Jour., vol. 49, No. 23, Oct. 12, 1950, pp. 84, 86, 88, 90, 95-6.

Includes a chart showing relationship between octane number and gasoline yield, fuel requirements, and cost of a 100,000-barrel-per-day refinery.

146. HOLLAND, A. A. New Type Evaporator. Chem. Eng., vol. 58, No. 1, January 1951, pp. 106-7.

Evaporator for dehydration of Glauber's salt eliminated scale, cut dust loss, slashed equipment costs, and reduced fuel bills. Mentioned price of rotary drier complete with transmission and motor as $40,000 to $75,000 and evaporator cost as one-third to one-fifth this amount.

147. HOLT, B. M. Hypersorption for Propane Recovery (Abstract of a paper). Petrol. Proc., vol. 4, No. 6, June 1949, pp. 681-2.

Investment and operating costs for hypersorption unit for propane recovery.

148. HORNADAY, G. F., NOLL, H. D., PEAVY, C. C., and WEINRICH, W. Various Refinery Applications of Houdriflow Catalytic Cracking. Oil Gas Jour., vol. 47, No. 49, Apr. 7, 1949, pp. 90-4.

Summarized the economics of processing 10,000 barrels per day of East Texas crude by the following methods:

1. Thermal cracking.
2. Vacuum distillation and once through cat cracking.
3. Visbreaking and once through cat cracking.
4. Coking and once through cat cracking.
5. Visbreaking and recycle cat cracking.
6. Coking and recycle cat cracking.

Catalytic cracking in each case was Houdriflow.

149. _____. Various Refinery Applications of Houdriflow Catalytic Cracking. Petroleum Eng., vol. 21, No. 7, Reference Annual 1949, pp. C3, 7-10.

Includes essentially the same information as reference 148.

150. HORRIDGE, E. T. The Economics of Motor Voltage Selection. Petrol. Refiner, vol. 28, No. 5, May 1949, pp. 133-9.

A thorough presentation of the subject of motors used in process plants. By means of numerous graphs the costs of various motors and motor controllers may be determined.

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151. HOWEY, C. R. Evaluation Rules Out Profitless Projects. Chem. Ind., vol. 67, No. 5, November 1950, pp. 724-5, 742.

Discusses necessity of having an economic-evaluation program as part of chemical industries, and gives some arbitrary figures to emphasize the point.

152. HUBBARD, D. O. Optimum Operating Currents for Hooker Type S Cells. Chem. Eng. Prog., vol. 46, No. 9, September 1950, pp. 435-9.

Investment and operating costs for Hooker S and type S-3 chlorine cells employed in plants whose capacities range from 25 to 200 tons. Also shown is investment return based on plant size and type of cell.

153. HULL, W. Q., in collaboration with GUTHRIE, BOYD, and SIPPRELLE, E. M. Liquid Fuels From Oil Shale. Ind. Eng. Chem., vol: 43, No. 1, January 1951, pp. 2-15.

Detailed report on liquid fuels from oil shale with cost data confined to mining companies.

154. INDUSTRIAL AND ENGINEERING CHEMISTRY. Thermal But Internal. Vol. 41, No. 12, December 1949, pp. 12A, 14A.

Cost of high-frequency heating units; a 1 kilowatt laboratory unit, $2,000; a 100-kilowatt unit, $50,000 to $65,000.

155. IRWIN, W. Y., and FRENCH, A. H. Treatment of Felt Paper Mill Wastes, Part II - Pilot Plant Operation - Bacterial Filtration. Chem. Eng. Prog., vol. 45, No. 2, February 1949, pp. 119-28.

Detailed description of the disposal process. Brief mention of investment and operating cost and depreciation rate.

156. JACOBS, H. L. If Your Wastes Need Not Be Separated. Chem. Eng., vol. 58, No. 5, May 1951, pp. 127-31.

General discussion of industrial plant waste disposal. Brief mention of investment and operating costs.

157. JAMISON, E. A. Liquefied Petroleum Gas, Industry's Standby. Chem. Eng., vol. 57, No. 5, May 1950, pp. 117-8.

Example of how to determine the economics of a liquefied petroleum-plant standby installation.

158. JANDRISEVITS, PETER. Preliminary Estimating By Selective Unit Costs. Ind. Eng. Chem., vol. 43, No. 10, October 1951, pp. 2299-2301.

Development of a preliminary overall estimate based on selected unit costs. Estimate includes the following major components: Process equipment, building, outside facilities and service connections, plant utilities, and contingency and supplementary information or requirements. Major components are further subdivided into smaller units. A detailed sample of a completed estimate is furnished.

159. JEWELL, J. W., Jr., and CONNOR, J. P. Economics of Petroleum Coking for Catalytic Cracking Feed Preparation. Oil Gas Jour., vol. 49,No. 29, Nov. 23, 1950, pp. 64-5, 75.

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Overall economic comparison for preparing catalytic feed stock by the following methods: Delayed coking, vacuum distillation, propane decarbonization, and visbreaking.

160. JEWELL, J. W., Jr., and CONNOR, J. P. Economics of Petroleum Coking for "Cat Cracking" Feed Preparation. Petrol. Proc., vol. 5, No. 11, November 1950, pp. 1199-1201.

Includes essentially the same information as references 159 and 161.

161. _____. Economics of Petroleum Coking for Catalytic Cracking Feed Preparation. Petrol. Refiner, vol. 30, No. 2, February 1951, pp. 75-77.

Includes essentially the same information as references 159 and 160.

162. JEWELL, J. W., Jr., and KING, C. C. Sulfuric Acid Alkylation for Gasoline. Petrol. Eng., vol. 23, No. 5, May 1951, pp. C24-6, 29, 30.

Compares two types of sulfuric acid alkylation reactors, namely; external emulsion circulation and internal emulsion circulation. Investment and operating costs given for units of 500-, 1,000-, 2,500-, and 5,000-barrels-per-stream-day capacity.

163. _____. Sulfuric Acid Alkylation - for Motor and Aviation Gasolines. Oil Gas Jour., vol. 50, No. 15, Aug. 16, 1951, pp. 120, 122, 125, 151-2, 154, 156, 159.

Includes essentially the same information as reference 162.

164. KAHLER, F. H., and MORRISON, W. S. How to Cut Costs in Deionization. Chem. Eng., vol. 58, No. 5, May 1951, pp. 175-6.

Economics of presoftening and mixed bed deionization.

165. KANOWITZ, S. B. Roller Mill Maintenance. Chem. Eng., vol. 58, No. 11, November 1951, pp. 268-9.

Points out disagreements with maintenance costs by J. D Leonard in reference 185.

166. KASTENS, M. L., and SUTHERLAND, ROBERT. Platinum Reforming of Gasoline. Ind. Eng. Chem., vol. 42, No. 4, April 1950, pp. 582-93.

Discussion of platforming gasoline at the Old Dutch Refinery, including design, flow diagram, operating data, and chemistry. Operating costs based on charge of 1,500 to 2,000 barrels per day together with investment costs for plants charging 1,500, 5,000, and 10,000 barrels per day.

167. KAYAN, C. F. Heat Pump Expected to Find Use in Waste Heat Recovery. Chem. Eng., vol. 57, No. 5, May 1950, pp. 146-7, 150.

Indicates that such a pump may compete favorably with conventional recovery method in some cases.

168. KELSO, GEORGE, PEAVY, C. C., MYERS, G. D., and HOGE, A. W. Design and Operation of Leonard T.C.C. Unit. Petrol. Eng., vol. 20, No. 1, October 1948, pp. 293-4, 296, 298, 300.

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Cost of a small T.C.C. unit estimated at $250 to $350 per daily barrel of reactor charge capacity, based on construction of the Leonard T.C.C. unit, which incorporated an existing thermal unit into the new construction.

169. KENYON, R. L., and BOEHMER, N. Phenol by Sulfonation. Ind. Eng. Chem., vol. 42, No. 8, August 1950, pp. 1446-55.

Brief mention of plant costs for phenol production. History, chemical reactions, flow diagrams for sulfonation process and sulfur dioxide byproduct recovery, and operations discussed.

170. KENYON, R. L., and INSKEEP, G. C., in collaboration with JILLETTE, LESLIE, and PRICE, J. F. Amyl Compounds From Pentane. Ind. Eng. Chem., vol. 42, No. 12, December 1950, pp. 2388-2401.

Flow diagrams and discussion of operations for the production of amyl compounds from petroleum pentane.

Cost distribution
(cents per dollar of total cost)

	Cost		
	Amyl chloride	Amyl alcohol	Amyl acetate
Raw material cost less byproduct credit.....	67	1/78	1/91
Direct labor and supplies.....	20	12	4
Indirect labor and supplies.....	13	10	5

1/ Includes starting amyl compound at factory cost.

171. KERN, D. Q. A Cheaper Way to Buy A Plant - Know What You Need. Chem. Eng., vol. 57, No. 7, July 1950, pp. 138-41.

No actual costs mentioned; however, providing the contractor with detailed specifications for a desired plant results in lower overall cost and a plant that suits the owner's needs.

172. KIDDOO, GORDON. Turnover Ratios Analyzed. Chem. Eng., vol. 58, No. 10, October 1951, pp. 145, 148.

Gives factors that influence the ratio of sales value to plant investment for chemical products. Lists investment in dollars per annual ton of capacity, product value (sales) in dollars per ton, and turnover ratio for approximately 80 chemical processes.

173. KLOSE, A. A., STARK, J. B., PURVIS, G. G., PEAT, JEAN, and FEVOLD, H. L. Ascorbic Acid From Walnut Hulls. Ind. Eng. Chem., vol. 42, No. 2, February 1950, pp. 387-91.

Yields and experimental details for recovery of ascorbic acid from waste walnut hulls. Cost estimate, based on pilot-plant data, showed process economically unfavorable unless other use of the equipment could be made during the off season.

174. KNECHT, G. B. The Case for a Small Nitric Acid Plant. Chem. Ind., vol. 66, No. 3, March 1950, pp. 357-9, 417.

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Estimate of operating expenses for a small nitric acid plant using catalytic oxidation of ammonia process.

175. KNIEL, LUDWIG. Propane Recovery By Absorption. Petrol. Eng., vol. 21, No. 7, Reference Annual 1949, pp. C45-6, 48, 51-2.

Discussion of design and operation of plant for propane recovery by absorption. Economics briefly mentioned.

176. KOHL, A. L., and FOX, E. D. Economics of Sulfur Production From Hydrogen Sulfide. Oil Gas Jour., vol. 50, No. 42, February 25, 1952, pp. 154, 156-7, 159, 177.

Net production cost of sulfur from plant associated with other operations ranges from $8.42 per ton for 20-long ton per day to less than $2 for 320-ton unit. Gives investment and operating costs for plants of 20, 40, 80, 160, and 320 long tons per day.

177. KOHLINS, W. D., and DEMAREST, E. L. Waste Utilization and Disposal Systems. Cost Studies of Evaporation and Drying. Chem. Eng. Prog., vol. 46, No. 12, December 1950, pp. 597-600.

Economics of waste utilization and disposal in the fermentation, paper, fishing, metal finishing, and dairy industries. Flow diagrams included.

178. KOREN, W. A. Roller Mill Maintenance. Chem. Eng., vol. 58, No. 11, November 1951, pp. 269-70.

Points out disagreements with maintenance costs by J. D. Leonard in reference 185.

179. KORSMEYER, E. W. How to Interpret Earnings Changes in an Oil Company. Petroleum Refiner, vol. 29, No. 11, November 1950, pp. 109-12.

Discussion offers a practical procedure for accounting for the difference between sales and costs of sales from one period to another in terms of principal causes. Relates sales costs to operating costs for an oil refinery.

180. LAPPLE, C. E. Processes Use Many Collector Types. Chem. Eng., vol. 58, No. 5, May 1951, pp. 144-51.

Comprehensive article on the control of air pollution. Relative cost and performance data for gravity settling chambers, inertial separators, packed beds, scrubbers, cloth collectors, electrical precipitators, air filters, etc. These are further broken down into industrial types.

181. LAUDERBAUGH, A. B. Use of Liquefied Petroleum Gas for Peak Loads. Oil Gas Jour., vol. 48, No. 1, May 12, 1949, p. 96.

Investment costs for liquefied petroleum gas standby installations.

182. LAURENCE, L. L. Natural-Gas Dehydration Using Triethylene Glycol. Oil Gas Jour., vol. 50, No. 35, Jan. 7, 1952, pp. 76-7.

Gives brief summary of operating costs.

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183. **LEMAY, J. W., Jr.** Costing Method for Natural Gasoline. National Association of Cost Accountants Bulletin, vol. 33, No. 3, November 1951, pp. 324-31.

Describes a breakdown of operations into process cost units for cost control, the characteristic difficulties of cost estimating the fractionation of gasoline, and the presentation of end-product costs in functional detail rather than by cost of contributing products plus immediate processing costs.

184. LEONARD, J. D. Roller Mill Maintenance. Chem. Eng., vol. 58, No. 11, November 1951, pp. 270, 272.

Reply to letters written by Kanowitz, S. B. (reference 165) and Koren, W. A. (reference 178) concerning disagreement of maintenance cost figures in original article (reference 185) by J. D. Leonard.

185. _____. What Does Maintenance Cost? Here Are Actual Cost Data to Help You. Chem. Eng., vol. 58, No. 9, September 1951, pp. 149-53.

Cost data presented that assist in the preparing new plant maintenance cost estimates and make cost-reduction programs more effective. Covers items such as: Filter; crushers and grinders; pumps; tanks; centrifugals; driers; evaporators; furnaces and kilns; crystallizers; conveyors; distillation columns; heat exchangers; dust- and mist-collecting equipment; screens, sifters, and mixers; clarification equipment and piping; and instruments.

186. _____. Why Multiply Your Utility Bills by a Waste Factor? Chem. Eng., vol. 58, No. 4, April 1951, pp. 112-3, 116.

Proposes budgetary control, utility incentives, and individual studies of major consumption points for cutting high cost of utilities.

187. LOOMIS, R. C. New Light on the Economics and Operation of Portable Gas-Engine Compressor Units. Oil Gas Jour., vol. 50, No. 52, May 5, 1952, pp. 258, 260-1, 263.

Compares cost of a stationary compressor with that of a portable one. The latter is less costly per compressor horsepower.

188. LOWD, J. D. Cold-Separation Processing. Oil Gas Jour., vol. 50, No. 8, June 28, 1951, pp. 81-5, 87-8, 90.

Compares equipment and insulation costs of conventional and cold-separation methods for removing condensable liquids from natural gas.

181. LYNCH, R. H. An Economic Study of a Products Pipe Line. Petrol. Eng., vol. 22, No. 12, November 1950, pp. D24, 26, 28, 30, 32, 34.

Analyzes the factors involved in constructing a pipeling by working out a hypothetical case, involving four pipe size alternatives. Graphs show figures on barrels per day versus: (1) Annual revenue and costs, (2) capital investment, and (3) percent return on investment.

190. _____. Economics of a Products Pipe Line. Oil Gas Jour., vol. 49, No. 28, November 16, 1950, pp. 214, 217, 220, 224.

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Includes essentially the same information as reference 189.

191. McALLISTER, S. H. Shale Oil As A Future Source of Energy in Western States. Petrol. Proc., vol. 5, No. 10, October 1950, pp. 1076-9.

Cost estimate for producing 97 Research octane number gasoline from petroleum, natural gas, coal, and oil shale.

192. McCONOMY, H. F., and HUR, J. J. What Can Be Done to Combat Corrosion of Refinery Tank Roofs? Petrol. Refiner, vol. 31, No. 5, May 1952, pp. 124-6.

Gives results of an extensive study of various materials that could prolong the serviceable life of refinery-tank roofs. Includes materials, fabrication, and installation costs and repair cost equations.

193. McCULLOUGH, G. E. Concentration of Radioactive Liquid Waste by Evaporation. Ind. Eng. Chem., vol. 43, No. 7, July 1951, pp. 1505-9.

Illustrates by discussion, pictures, and flow diagram an evaporation method for concentrating miscellaneous wastes at the Knolls Atomic Power Laboratory, Schenectady, N. Y. Costs were calculated based on actual operation of the plant at the rate of over 100,000 gallons of waste per month.

194. McGRATH, H. G. The Application of Fluid Hydroforming. Petrol. Refiner, vol. 30, No. 12, December 1951, pp. 102-8.

Discusses the economics for a 7,500-barrel-per-day unit, including credits and debits, operating cost, taxes, insurance, royalties, investment, payout time, and T.E.L. stock cost.

195. MARSHALL, W. R., Jr., and SELTZER, Edward. Principles of Spray Drying, Part II - Elements of Spray-Dryer Design. Chem. Eng. Prog., vol. 46, No. 11, November 1950, pp. 575-84.

Discusses mechanics of spray drying and includes equipment sketches. Economics of spray drying with respect to operation and installation costs per pound of water evaporated per hour.

196. MINES MAGAZINE (COLORADO). Report of National Petroleum Council Committee on Synthetic Liquid Fuels Production Cost, vol. 42, No. 3, March 1952, pp. 39-41.

Summary of National Petroleum Council Committee on Synthetic Liquid Fuels report on estimated costs of gasoline production from coal hydrogenation and oil shale.

197. MINEVITCH, J. R., KNIGHT, G. B., ROOT, S. E., and BORAKS, H. E. Chemical Plant Construction Cost, Indoors Versus Outdoors. Chem. Eng. Prog., vol. 47, No. 8, August 1951, pp. 385-91.

Operating and economic advantages and disadvantages of outdoor and indoor chemical plants and petroleum refineries. Cost comparison of the two types given.

198. MOLAISON, H. J., DECKBAR, F. A., and COOK, N. C. Pilot Plant Equipment Costs. Chem. Eng., vol. 57, No. 4, April 1950, pp. 110-11.

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Presents figures for determining pilot-plant costs. Material and fabrication costs of pilot-plant equipment itemized.

199. MONET, G. P. Cost of Ion Exchange. Chem. Eng., vol. 57, No. 3, March 1950, pp. 106-7.

Enables one to roughly calculate the cost of installing and operating an ion-exchange unit.

200. MULLINS, P. V Removal of Nitrogen From Natural Gas. Petrol. Eng. , vol. 23, No. 1, January 1951, pp. D36-7.

Estimates vary from $2,300,000 to $5,000,000 for a plant with a processing capacity of 100,000,000 cu. ft. of gas per day, removing 10 to 15 percent nitrogen under typical conditions of interest for this study. Operating costs range from $0.012 to $0.035 per 1,000 cu. ft. of gas processed.

201. MURPHREE, E. V. A Look at the Synthetic Fuels Picture. Petrol. Refiner, vol. 28, No. 3, March 1949, pp. 95-6.

Cost comparison of synthetic fuels production from coal and oil shale with production from crude petroleum and natrual gas.

202. _____. Fundamentals of Fluid Hydroforming. Petrol. Refiner, vol. 30, No. 12, December 1951, pp. 97-101.

Comparison of investment and operating costs for 10,000 barrel-per-day fixed bed and fluid bed hydroforming plants.

203. _____. Natural Gas, Coal, Oil Shale as a Source of Liquid Fuels. Mines Mag. (Colo.), vol. 38, No. 12, December 1948, pp. 89-92, 110-11, 114.

Comparison of investment and operating costs for gasoline production and middle-distillate production from crude oil, natural gas, coal, and oil shale.

204. _____. The Synthetic Fuels Picture. World Oil, vol. 128, No. 10, Feb. 1, 1949, pp. 46-8, 50.

Includes essentially the same information as reference 203.

205. NATIONAL PETROLEUM COUNCIL. Synthetic Fuels Production Costs. October 15, 1951, 555 pp.

Subcommittee Report to National Petroleum Council Committee on Synthetic Fuels Production Costs. A comprehensive cost study of the production of synthetic liquid fuels by coal hydrogenation and from oil shale. Report covers such aspects as coal-hydrogenation and shale-oil raw materials, processes, engineering, and economics.

206. NELSON, W. L. Cost-imating. Oil Gas Jour.

A weekly series of 63 articles, appearing in The Oil and Gas Journal, on estimating costs pertaining to the petroleum and chemical industry. Each article presents a detailed breakdown of costs for the various subjects listed below:

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Ref. No.	Title	Vol.	No.	Page	Date
206-1	Construction Cost Indexes	47	25	141	Oct. 21, 1948
-2	Exchangers	47	26	117	Oct. 28, 1948
-3	Construction Steel	47	27	111	Nov. 4, 1948
-4	Use of Cost Indexes	47	28	387	Nov. 11, 1948
-5	Storage Tanks	47	29	123	Nov. 18, 1948
-6	Petrochemical and Small Tanks	47	30	133	Nov. 25, 1948
-7	Lumber	47	31	115	Dec. 2, 1948
-8	Summary Sheets for Cost Estimates	47	32	117	Dec. 9, 1948
-9	Vessels	47	33	113	Dec. 16, 1948
-10	Special Vessels	47	34	81	Dec. 23, 1948
-11	Fractionating Towers	47	35	277	Dec. 30, 1948
-12	Estimate of a Fractionator	47	36	93	Jan. 6, 1949
-13	Tower Insulation and Platforms	47	37	101	Jan. 13, 1949
-14	Simplified Cost Estimates	47	38	97	Jan. 20, 1949
-15	Pipe Insulation	47	39	351	Jan. 27, 1949
-16	Insulation for Cold-1	47	40	91	Feb. 3, 1949
-17	Insulation for Cold-2	47	41	107	Feb. 10, 1949
-18	Ladders, Walkways, and Platforms	47	42	137	Feb. 17, 1949
-19	Depreciation Rates-Refining	47	43	187	Feb. 24, 1949
-20	Clay and Cement Pipe	47	44	99	Mar. 3, 1949
-21	Depreciation Rates-Petroleum	47	45	111	Mar. 10, 1949
-22	Cost of Building	47	46	191	Mar. 17, 1949
-23	Pump and Control Houses	47	47	303	Mar. 24, 1949
-24	Brick and Tile	47	48	125	Mar. 31, 1949
-25	Pipe Stills	47	49	109	Apr. 7, 1949
-26	Furnace Details	47	50	125	Apr. 14, 1949
-27	Tubes and Bends	47	51	243	Apr. 21, 1949
-28	Structural Steel Frame	47	52	141	Apr. 28, 1949
-29	Centrifugal Pumps	47	53	103	May 5, 1949
-30	Pump Materials and Drives	48	1	121	May 12, 1949
-31	Large Motors	48	2	363	May 19, 1949
-32	Electrical equipment	48	3	115	May 26, 1949
-33	Filter-Press Costs (Petrochemicals)	48	4	81	June 2, 1949
-34	Instrumentation	48	5	101	June 9, 1949
-35	Instrument Costs	48	6	141	June 16, 1949
-36	Compressors	48	7	223	June 23, 1949
-37	Blowers and Compressors	48	8	91	June 30, 1949
-38	Refrigeration Plants	48	9	95	July 7, 1949
-39	Refrigeration Auxiliaries	48	10	111	July 14, 1949
-40	Construction Costs 1948-49	48	11	101	July 21, 1949
-41	Structural Steel-Pipe Stills, etc.	48	12	339	July 28, 1949
-42	Pipes and Tubing	48	13	65	Aug. 4, 1949
-43	Chemical Equipment-1	48	14	109	Aug. 11, 1949
-44	Pipe Line Construction	48	15	159	Aug. 18, 1949
-45	Refinery Valves	48	16	143	Aug. 25, 1949
-46	Fittings and Flanges	48	17	71	Sept. 1, 1949
-47	Chemical Equipment-2	48	18	107	Sept. 8, 1949
-48	Piping	48	19	137	Sept.15, 1949
-49	Vacuum Equipment	48	20	299	Sept.22, 1949
-50	Coil-in-Box Equipment	48	21	91	Sept.29, 1949
-51	Chemical Equipment-3	48	22	343	Oct. 6, 1949
-52	Excavation, Concrete, and Foundations	48	23	135	Oct. 13, 1949
-53	Road Building	48	24	135	Oct. 20, 1949

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Ref. No.	Title	Vol.	No.	Page	Date
206-54	Fire Protection and Miscellaneous	48	25	91	Oct. 27, 1949
-55	Refinery Labor	48	26	97	Nov. 3, 1949
-56	Steam-Jet Ejectors and Freight Rates	48	27	377	Nov. 10, 1949
-57	Effect of Size on Cost	48	28	103	Nov. 17, 1949
-58	Over-All Plant Costs-Cracking (Approximate)	48	29	149	Nov. 24, 1949
-59	Over-All Plant Costs-Distillation, etc. (Approx.)	48	30	93	Dec. 1, 1949
-60	Over-All Plant Costs-Miscellaneous (Approx.)	48	31	91	Dec. 8, 1949
-61	A Refinery Cost Index	48	32	91-2	Dec. 15, 1949
-62	Current Itemized Indexes	48	33	283	Dec. 22, 1949
-63	Alphabetical Index	48	34	81	Dec. 29, 1949

207. _____. Cost-imating. Oil Gas Jour.

A quarterly series of cost estimating articles appearing in The Oil and Gas Journal in January, April, July, and October issues of each year (usually the first issue of the month). A continuation of reference 206 showing current equipment, plants, and associated costs.

Ref. No.	Title	Vol.	No.	Page	Date
207-1	Current Itemized Cost Indexes	48	48	93	Apr. 6, 1950
-2	Construction Costs Rise Slowly	49	9	67-8	July 6, 1950
-3	Current Cost Indexes	49	22	263-4	Oct. 5, 1950
-4	Current Itemized Cost Indexes	49	35	69	Jan. 4, 1951
-5	Cost Indexes Brought to Date	49	49	109	Apr. 12, 1951
-6	Cost Indexes-Costs Are Rising	50	9	88	July 5, 1951
-7	Costs Hold Steady After February	50	22	327	Oct. 4, 1951
-8	Costs Show Rising Tendency	50	35	91	Jan. 7, 1952
-9	Current Itemized Construction Cost Indexes	50	48	139	Apr. 7, 1952

208. _____. Economic Thickness of Insulation. Oil Gas Jour., vol. 47, No. 24, Oct. 14, 1948, p. 117. (Data of L. B. McMillan.)

Graphs permit determination of proper type and thickness of insulation to use for pipes with consideration given to cost of heat, cost of insulation, and fixed charges.

209. _____. Petroleum Refinery Engineering, McGraw-Hill Book Co. Inc., New York, N. Y., 3d ed., 1949, 830 pp.

Chapter XXIX, Economics of Design, covers investment and operating cost breakdown of refinery processes in essentially all types of refinery operations. Included also are plant and equipment costs, depreciation rates, and related pertinent data.

210. _____. Questions on Technology. Oil Gas Jour.

A series of articles appearing in the Oil and Gas Journal entitled "Questions on Technology" from which those pertaining to costs are listed:

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Ref. No.	Title	Vol.	No.	Page	Date
210-1	Increase in Refinery Construction Costs	47	30	128	Nov. 25, 1948
-2	Amortization and Depreciation	47	40	90	Feb. 3, 1949
-3	Fractionating Tower Costs	47	40	90	Feb. 3, 1949
-4	Machinery Cost Indexes	47	42	132	Feb. 17, 1949
-5	Painting Costs	48	1	116	May 12, 1949
-6	References to Costs	48	8	81	June 30, 1949
-7	Cost of Lube-Oil Refining	48	17	61	Sept. 1, 1949
-8	Small Exchanger Costs	48	42	195	Feb. 23, 1950
-9	Small Exchangers Used in Engines: Cost Is Low	48	50	248	Apr. 20, 1950
-10	Operating Cost Index	49	10	98	July 13, 1950
-11	Gasoline Reforming by Platforming	49	12	336	July 27, 1950
-12	Cost of Vacuum Plants	49	21	98	Sept.28, 1950
-13	Effect of Plant Size on Cost of Operation	49	36	98	Jan. 11, 1951
-14	Refineries Not Package Units	49	43	78	Mar. 1, 1951
-15	Refinery Accounting References	49	48	100, 103	Apr. 5, 1951
-16	Maintenance Costs	49	48	103	Apr. 5, 1951
-17	Relative Cost of Coal or Oil Firing	50	10	106	July 12, 1951
-18	Relative Value of Coal and Fuel Oil	50	11	114	July 19, 1951
-19	Cost of Power	50	15	160	Aug. 16, 1951
-20	Plant Comparison of Value of Coal and Oil	50	20	329	Sept.20, 1951
-21	Cost of Carbon-Black Plants	50	23	140	Oct. 11, 1951
-22	Cost of Platformer Units	50	40	136	Feb. 11, 1952
-23	Meaning of Total Process Equipment Cost	50	40	136	Feb. 11, 1952
-24	Increase in Vessel Costs Since 1946	50	50	171	Apr. 21, 1952
-25	Replacement Value and Depreciation Rate	51	4	111-2	June 2, 1952

211. _____. Nelson Refinery—Construction Index. Oil Gas Jour.

A series of refinery-construction cost indexes appearing in the first issue each month of The Oil and Gas Journal under Refining News. These are kept current, the time lag being 3 to 4 months, and deal with the following subjects: Centrifugal pumps, reciprocating pumps, compressors, engines, motors, transformers, instruments, materials component, and labor component. The explanation appears in Cost-imating (reference 206-61, Dec. 15, 1949, p. 92,) and the series begins with vol. 48, No. 35, Jan. 5, 1950, p. 89.

212. NEWTON, R. D. and ARIES, R. S. Preliminary Estimation of Operating Costs. Ind. Eng. Chem., vol. 43, No. 10, October 1951, pp. 2304-6.

The authors conclude that a preliminary evaluation of a new chemical process plant must include both capital expenditure and operating costs and ultimately an expression of profits. All operating expenses may be quantitatively related to raw materials, utilities, labor, or equipment. Factors that may be used for estimating are derived. Other factors that aid in determining profits are shown.

213. NICHOLS, W. T. Capital Cost Estimating. Ind. Eng. Chem., vol. 43, No. 10, October 1951, pp. 2295-8.

Several methods used for capital cost estimation described. The relative cost, complexity, and precision of the various methods shown by a graph.

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214. NICHOLS, W. T. Next Time, Give th Boss A Precise Capital Cost Estimate. Chem. Eng., vol. 58, No. 6, June 1951, pp. 248, 250.

Includes essentially the same information as reference 213.

215. NOBLE, F. G. Maximum Propane Recovery. Oil Gas Jour., vol. 47, No. 29, Nov. 18, 1948, pp. 95-6, 98-9.

Sets forth the economics and engineering problems associated with maximum recovery of propane from natural gas.

216. OBERSEIDER, J. L. Combustion Gas Turbine-Important New Prime Mover for the Gas Pipe-Line Industry. Oil Gas Jour., vol. 50, No. 14, Aug. 9, 1951, pp. 102, 104.

Investment, operating, and maintenance costs for a combustion gas turbine.

217. O'BRIEN, A. J., Jr. 1952 Outlook: Gas and Liquids From Coal. Chem. Eng., vol. 59, No. 4, April 1952, pp. 299-300, 302-4, 306-8, 310-2, 314.

Mention of investment cost for a Lurgi coal-gasification plant and for coal hydrogenation.

218. OIL and GAS JOURNAL. Refinery Loss Control. Vol. 48, No. 35, Jan. 5, 1950, p. 77.

Contains a table giving the costs of losses owing to various size pipe leaks.

219. _____. Synthetics - Costs Still Too High. Vol. 50, No. 50, Apr. 21, 1952. p. 100.

Discusses the Ebasco report on synthetic fuels from coal hydrogenation.

220. _____. Synthetic - Fuels Picture. Vol. 49, No. 28, Nov. 16, 1950, p. 184.

Estimated cost of $41,381,000 for a plant producing 8,840 barrels daily of refined products from oil shale, including facilities for mining, retorting, and refining.

221. _____. Synthetics Too Costly. Vol. 50, No. 27, Nov. 8, 1951, p. 172.

Overall costs given for producing synthetic fuels.

222. _____. Synthetics Too High. Vol. 50, No. 37, Jan. 21, 1952, p. 57.

Compares estimated investment and operating costs of coal hydrogenation by the National Petroleum Council and Bureau of Mines.

223. OLIVE, T. R. Compound Interest Charts Speed Engineering Economics Studies. Chem. Eng., vol. 59, No. 6, June 1952, pp. 206-7.

Article submitted by H. E. Schweyer. Method for making and illustration of calculations of theoretical compound interest relations involving a time period and money at some interest rate. Relates to engineering cost studies.

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224. PARKER, J. L. How Much It Will Cost You to Recover Sulfur from H_2S. Petrol. Proc., vol. 7, No. 3, March 1952, pp. 338-9.

Cost figures for sulfur recovery from hydrogen sulfide on the basis of 5-, 10-, and 15-ton-per-day plant capacity.

225. _____. Sulfur From H_2S. Oil Gas Jour. vol. 50, No. 47, Mar. 31, 1952, pp. 84-5, 95, 97.

Includes essentially the same information as reference 224.

226. PAYNE, J. W., EVANS, L. P., BERGSTROM, E. V., and BOWLES, V. D. Thermofor Catalytic Reforming Reaches Commercial Stage. Petrol. Refiner, vol. 31, No. 5, May 1952, pp. 117-23.

Thorough discussion of the development of the Thermofor catalytic reforming process with respect to the plant and a suitable catalyst. A comparison of investment costs for several size units and operating cost estimate for a 30,000 barrels per day Mid-Continent refinery.

227. _____. Thermofor Catalytic Reforming (TCR). Petrol. Eng., vol. 24, No. 6, June 1952. pp. C10, 13-8, 20.

Includes essentially the same information as reference 226.

228. PEABODY, A. W., and WOODY, C. L. Experience and Economic Benefits From Cathodic Protection on Gas-Distribution Systems. Corrosion, vol. 5, 1949, pp. 369-76.

Case histories of two different gas systems one employing rectifiers and the other galvanic anodes. Includes installation costs and mention of operating costs.

229. PEAVY, C. C., WEINRICH, W., NOLL, H. D., and HORNADAY, G. F. Houdriflow Catalytic Cracking Applied to Current Economics (abstract of a paper). Petrol. Proc., vol. 4, No. 5, May 1949, pp. 554, 557-8.

Economics of processing 10,000 barrels per calendar day of East Texas crude with the Houdriflow process in combination with thermal cracking, visbreaking, coking, and vacuum distillation.

230. PETROLEUM ENGINEER. Breather Balloon Reduces Vapor Losses. Vol. 21, No. 12, November 1949, pp. C39-40.

Costs for breather balloon installation for volatile petroleum product storage.

231. _____. Moving Bed Catalytic Cracking Process Improved. Vol. 21, No. 1, January 1949, pp. C23-4, 26.

Economic advantages of Houdriflow catalytic cracking over TCC process based on units of 5,000-barrels-per-stream-day capacity.

232. _____. New Adsorption Process Recovers Aromatics. Vol. 23, No. 9, August 1951, pp. C21-2, 24.

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Brief comment on investment and operating costs of the Arosorb process based on 10-year depreciation.

Capacity, barrel per day aromatics.....	1,000	2,000
Investment cost (thousands of dollars).....	$1,200	$1,900
Operating cost per gallon of aromatics.....	$0.065	$ 0.05

233. PETROLEUM ENGINEER. Optimum Insulation Thickness. Vol. 23, No. 2, February 1951, pp. C35-6.

Data enveloped by W. E. Somers. Costs of a given rate of heat loss in 1,000 B.t.u. per hour for the amortization life of the unit. Article concerned with insulation for ducts, flues, and equipment.

234. PETROLEUM PROCESSING. Coal Hydrogenation Is Improved for Making Synthetic Fuels. Vol. 4, No. 3, March 1949, pp. 243-7.

Engineering and cost study in detail for a 30,000-barrel-per-day hydrogenation plant using 5 different grades of coal.

235. _____. Economics in Catalytic Reforming. Vol. 6, No. 10, October 1951, p. 1056.

An economic balance sheet for a fluid hydroforming unit of 7,500-barrel-per-day capacity.

236. _____. Improved Process Developed for Retorting Oil Shale. Vol. 6, No. 7, July 1951, pp. 740-3.

Estimated capital requirements and operating and maintenance costs for producing and refining shale oil on the basis of 10,000 and 11,700 barrels per day of shale oil.

237. _____. Industry's vs. Bureau's Figures, Cost of Hydrogenating Coal to Gasoline. Vol. 7, No. 3, March 1952, pp. 321-3.

Comparison of National Petroleum Council's cost estimate with that of the Bureau of Mines for coal hydrogenation to produce gasoline.

238. _____. New Catalytic Reforming Process Shows High Octane Gain, Low Volume Loss (abstract of a paper). Vol. 4, No. 5, May 1949, pp. 553-4.

Estimates cost of $1,700,000 for a 5,000-barrel-per-day platforming unit.

239. _____. No Orchids for Bureau's Coal Hydrogenation Figures. Vol. 7, No. 5, May 1952, p. 712.

Discusses the Ebasco report on production of synthetic fuels by coal hydrogenation.

240. _____. Outside Engineering Firm to Audit Bureau's Synthetics Cost Data. Vol. 6, No. 12, December 1951, pp. 1380-1.

Summarizes the cost data for coal hydrogenation and oil shale plants as prepared by the National Petroleum Council subcommittee on synthetic liquid fuels.

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241. PETROLEUM PROCESSING. Platforming and Udex Extraction (abstract of a paper). Vol. 7, No. 6, June 1952, pp. 839-42.

Operating and economic data for platforming and Udex processes and their combination.

242. _____. Process Cost Studies Are Presented in Papers on Refining Economics. See references 105, 147, and 308.

243. _____. Recovery by Silica Gel Adsorption (abstract of a paper). Vol. 7, No. 6, June 1952, pp. 843-4.

Investment and operating costs for Arosorb process of 500, 2,500, and 5,000 barrels per day capacity.

244. PETROLEUM REFINER. Bureau's Cost of Oil to Shale 7.3 Cents Gallon. Vol. 29, No. 2, February 1950, p. 164.

Brief comment on Bureau of Mines estimate for producing liquid fuels from oil shale.

245. _____. Cost of Operating Electric Motors. Vol. 30, No. 12, December 1951, pp. 118-9.

Consists of a nomograph and an illustration of its use. Prepared by T. G. Hicks.

246. _____. History of Synthetic Fuels. Vol. 30, No. 12, December 1951, pp. 71-3.

Cost of producing catalytic gasoline ranges from $0.414 to $0.435 per gallon, according to National Petroleum Council.

247. _____. Nomograph for Compressed Air Cost. Vol. 31, No. 1, January 1952, p. 96.

Consists of a nomograph and an illustration of its use. Prepared by T. G. Hicks.

248. _____. Nomograph for Pumping Costs. Vol. 31, No. 2, February 1952, p. 104.

Consists of a nomograph and an illustration of its use. Prepared by T. G. Hicks.

249. _____. Nuclear Power Resources Committed. Vol. 29, No. 12, December 1950, pp. 67, 69.

Investment costs for nuclear reactors and cost per kilowatt hour installed capacity given.

250. _____. Simplicity of Process and Low Investment Cost Stressed. Vol. 28, No. 1, January 1949, pp. 110-12.

Discusses the Hourdriflow catalytic cracking process with respect to the T.C.C. process.

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251. PFARR, J. S., POLLARD, R. W., HARRIS, L. T., and DOUGHERTY, W. F. Maintenance in a Small Refinery. Oil Gas Jour., vol. 49, No. 2, May 18, 1950, pp. 145, 147, 150-3, 156.

Painting costs given.

252. _____. Maintenance Practices in a Small Refinery. Petrol. Eng., vol. 22, No. 7, Reference Annual, 1950, pp. C28-30, 32-4, 36.

Includes essentially the same information as references 251 and 253.

253. _____. Maintenance Practices in a Small Refinery. Petrol. Refiner, vol. 29, No. 5, May 1950, pp. 105-10.

Includes essentially the same information as references 251 and 252.

254. PFEIFER, V. F., TANNER, F. W., Jr., VOJNOVICH, CHARLES, and TRAUFLER, D. H. Riboflavin by Fermentation With Ashbya gossypii. Ind. Eng. Chem., vol. 42, No. 9, September 1950, pp. 1776-81.

Includes pilot-plant data and brief summary of investment costs.

255. PHILLIPS, R. W., and MADIGAN, J. E. Automatic Dry Mixing Slashes Labor Cost in Fertilizer Plant. Chem. Eng., vol. 57, No. 3, March 1950, pp. 122-4.

Economic summary for a 60-ton-per-hour automatic fertilizer plant.

256. PIERCE, R. R. Pennsalt Gives: Key to Savings in Painting Costs. Chem. Eng., vol. 59, No. 5, May 1952, pp. 149-53.

Comprehensive evaluation and standardization program of maintenance painting with respect to chemical-industrial atmospheres. Includes such points as cost per square foot of coverage and touch up versus repainting costs.

257. READ, DAVIS. Production of High-Purity Aromatics for Chemicals. Petrol. Refiner, vol. 31, No. 5, May 1952, pp. 97-103.

Economics of the platforming and Udex process for producing high-purity aromatics as predicted by projecting pilot-plant data to an operation that processes 10,000 barrels per stream day of gasoline.

258. REED, F. H. Synthetic Liquid Fuels. Mines Mag. (Colo.), vol. 38, No. 10, October 1948, pp. 23-4.

Investment costs for fuels from coal hydrogenation, shale oil, and natural gas.

259. REEVES, R. V. 1952: Synthetic Liquid Fuels? Chem. Eng., vol. 58, No. 12, December 1951, pp. 314, 316.

Digest of National Petroleum Council's report on investigation of the economics of synthetic liquid fuels.

260. REYNOLDS, B. M. Economics of Plant Expansion. Chem. Eng., vol. 56, No. 5, May 1949, pp. 151-2.

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Economic factors conditioning chemical-plant expansion.

261. ROBERTS, GEORGE, Jr., and SCHULTZ, P. R. Liquid Fuels From Coal and Oil Shale. Jour. Petrol. Technol., vol. 1, No. 9, sec. 1, September 1949, pp. 24-30.

Comparative cost estimates for producing liquid fuel from natural gas, oil shale, and bituminous coal.

262. _____. Liquid Fuels From Coal and Oil Shale. Petrol. Refiner, vol. 29, No. 1, January 1950, pp. 104-8.

Includes essentially the same information as references 261 and 263.

263. _____. Production of Liquid Fuels From Coal and Oil Shale. Oil Gas Jour., vol. 48, No. 19, Sept. 15, 1949, pp. 116-7, 120-1, 123-5.

Includes essentially the same information as references 261 and 262.

264. ROBERTS, IRVING. Economics of Tonnage Oxygen Production. Chem. Eng. Prog., vol. 46, No. 2, February 1950, pp. 79-88.

Economics for a plant producing 120 tons of 95-percent oxygen per day by the Elliott process. Graph enables cost estimates to be made for plant capacities up to 1,000 tons per day. Power for compression is major operating cost. Flow diagram and operational data included. Operational costs in detail.

265. RODGER, W. A., and FINEMAN, PHILLIP. Radioactive Waste Disposal. Chem. Eng., vol. 58, No. 12, December 1951, pp. 146-50.

Equipment, engineering, and costs involved in radioactive waste disposal at Argonne National Laboratories.

266. ROOSEBOOM, AUGUSTE, Urea A Process Survey. Chem. Eng., vol. 58, No. 3, March 1951, pp. 111-4.

Practical and theoretical discussion of urea production processes, including investment and operating costs.

267. ROWLEY, L. N. I. C. Engines and Gas Turbines Raising Fuel Economy. Chem. Eng., vol. 57, No. 5, May 1950, pp. 126-8.

Fuel savings for diesel-fuel engines burning gas compared with oil diesels.

268. SANDS, A. E., and SCHMIDT, L. D. Recovery of Sulfur From Synthesis Gas. Ind. Eng. Chem., vol. 42, No. 11, November 1950, pp. 2277-87.

Primarily discusses removal of hydrogen sulfide from synthesis gas with special reference to sulfur recovery. Shows purification and recovery cost estimates related to hydrogen sulfide, organic sulfide, and total sulfur removal.

269. SCHROEDER, A. L., and SCHWARTZ, H. W. Low Temperature Vacuum Dehydration. Chem. Eng. Prog., vol. 45, No. 6, June 1949, pp. 370-6.

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Pilot-plant cost data indicate that high vacuum dehydration is considered a feasible industrial process. Includes investment and operating costs for continuous-drying plants with capacities of 10, 50, and 200 pounds of water per hour. Total direct costs for handling 1 pound of water vapor. Dehydration represents 2 to 4 percent of the total manufacturing cost for expensive items such as orange juice and coffee.

270. SCHROEDER, W. C. Synthetic Fuel Production. Petrol. Eng., vol. 22, No. 5, May 1950, pp. A53, 56, 60, 63-4, 66, 68.

Brief mention of estimated cost per day for synthetic fuels from coal, oil shale, and natural gas, together with a general discussion of synthetic liquid fuels.

271. SCHULTZ, P. R. Facts, Not Fiction About Synthetic Liquid Fuels. Petrol. Refiner, vol. 31, No. 3, March 1952, pp. 88, 90, 93-4, 96-8.

Discussion of synthetic liquid fuels costs reported by National Petroleum Council, compared with those costs reported by the Bureau of Mines.

272. SCHUTTE, A. H. Application of Contact Coking to California Refining. Oil Gas Jour., vol. 48, No. 26, Nov. 3, 1949, pp. 70-1, 92.

Operating and economic data for a 30,000-barrel-per-day refinery charging crude oil and operating with three different processes, namely: (1) Topping, cat cracking, thermal cracking, and distillate treating facilities; (2) contact coking plus recycle cat cracking; and (3) contact coking plus once-through cat cracking.

273. _____. Contact Coking. Petrol. Eng., vol. 22, No. 7, Reference Annual 1950, pp. C37-8, 40-2.

Includes essentially the same cost data as reference 272.

274. SCHUTTE, A. H., and ROSE, K. E. Emulsion Deoiling of Crystalline Waxes. Petrol. Eng., vol. 21, No. 5, May 1949, pp. C7-12.

Describes the emulsion deoiling process. Investment and operating costs stated to be one fifth to one third of that for conventional sweating plants.

275. SEEBOLD, J. E., BERTETTI, J. W., SNUGGS, J. F., and BOCK, J. A. Destrehan Fluid Hydroformer Scheduled for Operation Soon. Petrol. Refiner, vol. 31, No. 5, May 1952, pp. 114-6.

First fluid hydroformer. Describes anticipated operational behavior of unit and shows estimated operating costs.

276. _____. Fluid Hydroforming, Full-Scale Unit. Oil Gas Jour., vol. 51, No. 2, May 19,1952, pp. 111, 135-6, 139-41.

Includes essentially the same information as reference 275.

277. SHEPARDSON, R. M., TYSON, C. W., and VOORHIES, A., Jr., Fluid Hydroforming, Pilot Plant. Oil Gas Jour., vol. 51, No. 2, May 19, 1952, pp. 110, 136-41.

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Operating data and cost comparison of fluid hydroforming with thermal reforming and polymerization.

278. SHERWOOD, P. W. Acetylene From Petroleum Gases. Petrol. Refiner, vol. 27, No. 11, November 1948, pp. 93-7.

Cost of producing 1 pound of acetylene by the following methods:

	Electric arc	Regenerative furnace (vacuum system)	Partial oxidation
In dilute form 8 to 16 percent (allowing $0.15 per million B.t.u. gas credit for diluent gas).....	$0.049	$0.045	$0.042
In 98 percent concentration.....	.079	.080	-
In 70 percent concentration.....	-	-	.067

279. _____. Effect of Plant Process Size on Capital Cost. Oil Gas Jour., vol. 48, No. 44, Mar. 9, 1950, pp. 81, 83-4, 95.

Graphs enable estimation of original and expansion costs for several process plants. Exponential factors discussed.

280. _____. High-Pressure Hydrogenation of Carbonaceous Matter. Petrol. Refiner, vol. 29, No. 8, August 1950, pp. 107-10.

Overall requirements and performance of high-pressure hydrogenation applied to petroleum oils and residuum, coke-oven tar, coal tar, lignite, and coal. Gives consideration to the economics and thermal efficiencies of the process.

281. _____. How to Prepare Preliminary Cost Evaluation Reports. Petrol. Refiner, vol. 31, No. 6, June 1952, pp. 126-30.

Gives procedure and works out examples for preparing cost-evaluation reports.

282. _____. Shale Oil Production and Refining Today. Petrol. Refiner, vol. 31, No. 5, May 1952, pp. 160-4.

Economics and refining operations for converting shale oil into gasoline or diesel fuel.

283. SITTENFIELD, MARCUS. The Control of Air Pollution in the Chemical Industry. Chem. Eng. Prog., vol. 57, No. 9, September 1951, pp. 481-3.

Methods for controlling air pollution. Brief comment on costs for dynamic scrubbers, electrostatic precipitators, and ultrasonic agglomerators.

284. _____. The Economics of Petroleum Chemical Plant Location. Chem. Eng. Prog., vol. 45, No. 5, May 1949, pp. 316-22.

Discusses the location of petroleum chemical plants with particular emphasis placed on fuel and transportation cost. Where coal, natural gas, or fuel oil are abundant, it is more economical to synthesize chemicals from refinery gases than to use the latter as a fuel.

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285. SITTIG, MARSHALL. Catalytic Cracking. Petrol. Refiner, vol. 29, No. 6, June 1950, pp. 91-5.

A study of catalytic cracking developments through 1947. General statement is made that fluid catalytic cracking ranks highest in installation cost but lowest in cost per gallon of gasoline produced.

286. _____. Catalytic Cracking. Petrol. Refiner, vol. 29, No. 8, August 1950, pp. 99-104.

Concerned with the process control problems, catalyst transfer, catalyst regeneration, catalysts, and late developments of the TCC catalytic cracking process. Some costs and cost comparison factors included.

287. _____. How to Cut Costs - 14 Practical Tips. Chem. Eng., vol. 57, No. 7, July 1950, pp. 126-8.

Suggests the following 14 ways for reducing costs in a process plant:

1. Make a material balance.
2. Check operating standards.
3. Check process efficiency.
4. Cut careless waste with instrumentation.
5. Set up equipment operating records in writing.
6. Plot operating data graphically to spot unknown correlation in process.
7. Eliminate wasteful sampling by control units.
8. Consider making solutions more concentrated.
9. Recheck past employee suggestions.
10. Make a time study of plant operations.
11. Get maximum work from all research and pilot plant equipment.
12. Improve safety practices to cut down losses.
13. Prepare loss reports for materials lost in processing.
14. Write up modern operating procedures for operators.

288. SKINNER, E. L. The Role of Cost Accounting in Refinery Operating Control. Oil Gas Jour., vol. 50, No. 48, Apr. 7, 1952, pp. 117-8, 120, 122, 124.

No actual costs. Describes the procedure for applying cost accounting to refinery cost control.

289. _____. The Role of Cost Accounting in Refinery Operating Control. Petrol. Refiner, vol. 31, No. 4, April 1952, pp. 81, 83, 86, 88, 90.

Includes essentially the same information as reference 288.

290. SKINNER, L. C. DONATH, E. E., SCHAPPERT, H., and FRESE, E. Residual-Oil Hydrogenation. Petrol. Refiner, vol. 29, No. 7, July 1950, pp. 83-7.

Hydrogenation of residual oils to produce distillate fuels appears economical. Estimated plant costs range from $1,800 to $2,000 per daily barrel of product. Payout time from 4 to 8 years, depending upon geographical location. Processing and economics discussed.

291. SMITH, J. C. Cost and Performance of Centrifugals. Chem. Eng., vol. 59, No. 4, April 1952, pp. 140-2, 147.

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Purchase prices, installation costs, operating labor and maintenance, and performance and capacity figures for various types of centrifugals are shown in tables and graphs.

292. SNEDDON, RICHARD. Technologists Discuss Progress in Oil Shale. Petrol. Eng., vol. 21, No. 8, July 1949, pp. C36-7.

Summary of oil shale panel discussion under American Institute of Mining and Metallurgical Engineers auspices; brief mention of investment costs.

293. SOLLIDAY, A. L. Synthetics "Confusion." Oil Gas Jour., vol. 48, No. 46, Mar. 23, 1950, p. 160.

Investment cost estimates for shale oil and coal-hydrogenation plants.

294. SPENCE, L. U. Falling-Film High Vacuum Still. Ind. Eng. Chem., vol. 42, No. 9, September 1950, pp. 1926-9.

Operating data, design, and flow diagram for a falling-film high-vacuum still shown. Operating cost per hour and per pound of distilled product given.

295. SPROULL, W. T. Precipitators Stop Dust and Fumes. Chem. Eng., vol. 58, No. 5, May 1951, pp. 151-4.

Discusses the operation of Cottrell electric dust precipitators. Operational efficiency of these units increases as the size increases, which in turn cuts the cost per given amount of gas throughput.

296. STEINBOCK, S. R. Before You Insulate - .... Chem. Eng., vol. 58, No. 5, May 1951, pp. 173-4.

Economic evaluation of insulation versus increasing boiler capacity.

297. STENERSON, HARRY. Behind the Markets, Coal Hydrogenation Chemicals. Chem. Eng. News, vol. 30, No. 11, Mar. 17, 1952, p. 1160.

Plant costs for a 30,000-barrel-per-day coal-hydrogenation plant given.

298. STEWART, L. D. Economics of Waste Heat Recovery. Petrol. Eng., vol. 22, No. 9, August 1950, pp. C26, 31-4.

Covers such subjects as heat exchange between oil streams, waste heat boilers, exhaust steam in low pressure turbines, superheating exhaust steam, and use of exhaust steam for refrigeration. Examples of cost calculations included.

299. STEWART, R. S., and GUSTAFSON, H. A. Control of Maintenance Costs. Petrol. Eng., vol. 21, No. 7, Reference Annual 1949, pp. C11-4, 16, 18, 23-4.

Application of International Business Machine Co. automatic business-machine installations to refinery maintenance records to help reduce maintenance costs.

300. STORCH, H. H., ANDERSON, R. B., HOFER, L. J. E., HAWK, C. O., ANDERSON, H. C. and GOLUMBIC, N. Synthetic Liquid Fuels From Hydrogenation of Carbon Monoxide. Bureau of Mines Tech. Paper 709, 1948, 213 pp.

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Contains detailed record of experimental work done in 1943-46 on the effect of mode of catalyst preparation, reduction, and induction period on activity in the synthesis and on the boiling range of the product. Includes data on X-ray diffraction patterns, magnetic susceptibility, surface area, and porosity of the catalyst. Preceding the record of the experimental work is a review of literature pertaining to the subject. Costs were confined to a brief comment on investment costs per barrel of gasoline per day from thermal cracking, high-pressure coal hydrogenation, and the Fischer-Tropsch process.

301. STORM, L. W. The Synthetic Liquid Fuel Situation. Mines Mag. (Colo.), vol. 41, No. 10, October 1951, pp. 69-80.

Covers cost for the production of synthetic liquid fuels from oil shale and coal.

302. STORMONT, D. H. Conservation of Lease-Tank Vapors. Oil Gas Jour., vol. 50, No. 2, May 17, 1951, pp. 93-4, 96, 126-8.

Gives some idea of the costs involved in equipping lease-tankage with vapor-saving devices and value of the gas and products recovered by several installations.

303. _____. General Petroleum Licks Corrosion Problem in T. C. C. Catalyst-Handling Lines. Oil Gas Jour., vol. 50, No. 45, Mar. 17, 1952, pp. 266, 268-9.

Catalyst elevator chain costs approximately $0.17 per foot.

304. _____. Insulating Wash Tanks Pays Off - Payout in California Rendered in Less Than a Year. Oil Gas Jour., vol. 51, No. 4, June 2, 1952, pp. 88, 90, 94.

Insulation of wash tanks and stock tanks including costs.

305. _____. Tank-Vapor Recovery at Guijarral Hills Effects Payout in Few Months. Oil Gas Jour., vol. 50, No. 4, May 31, 1951, pp. 85-7.

Brief comment on tank and vapor-saving device investment cost.

306. SUITS, C. G. Nuclear Power Isn't Cheap - Yet. Chem. Eng., vol. 58, No. 3, March 1951, p. 246.

Compares electricity production cost from coal and nuclear reactors.

307. SUTHERLAND, E. K., and HANSON, D. D. Platforming of Natural Gasoline. Oil Gas Jour., vol. 48, No. 50, Apr. 20, 1950, pp. 177-8, 194-5, 197, 199-200, 203.

Includes a brief summary of operating and investment costs.

308. SUTHERLAND, R. E., and DOEGEY, J. L. Alkylation and Polymerization (abstract of a paper). Petrol. Proc., vol. 4, No. 6, June 1949, pp. 679-81.

Plant and operating costs of reactor polymerization, chamber polymerization, and hydrofluoric acid (HF) alkylation.

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309. TATOR, KENNETH. Cuts Paint Evaluation Time. Chem. Eng., vol. 58, No. 10, October 1951, pp. 140-2.

Gives costs for paints and for labor. Compares types of paint with costs.

310. TODD, RAYMOND. Conversion of Atmospheric Cooling Tower. Petrol. Eng., vol. 22, No. 2, February 1950, pp. C26, 28-9.

Costs included in a discussion of three alternatives for expanding cooling tower capacity, namely; Installation of radiator-type cooling, construction of a new induced-draft tower for conversion of the old tower to induced draft.

311. TORREY, P. D. Possibilities for Production of Liquid Fuels From Shale, Natural Gas, and Coal. Pt. 1, Petrol Eng., vol. 22, No. 3, March 1950, pp. A39-44; Pt. 2, Petrol. Eng., vol. 22, No. 4, April 1950, pp. A45-46.

Part 1 - Various aspects of synthetic liquid fuels production from oil shale and natural gas, with brief mention of costs. Part 2 - Discussion of synthetic liquid fuels from coal, including costs.

312. TURNER, O. M. Metering vs. Gaging of Products Pipe-Line Deliveries and Receipts. Here's an Economic Comparison. Oil Gas Jour., vol. 51, No. 7, June 23, 1952, pp. 65-6.

Investment and operating cost comparison of metering versus gaging on products pipeline.

313. UHL, W. C. Graphic Panels, the New Look in Instrumentation. Petrol. Proc., vol. 5, No. 4, April 1950, pp. 361-8.

Includes a cost comparison between conventional and graphic panels.

314. _____. Rapid Pay-Off in Saving Vapors. Petrol. Proc., vol. 4, No. 3, March 1949, pp. 249-53.

Investment and operating costs of a gasholder-type vapor-saving unit together with operating data and cost savings.

315. UHLIG, H. H. The Cost of Corrosion to the U. S. Chem. Eng. News, vol. 27, No. 39, Sept. 26, 1949, pp. 2764-7.

Comprehensive report on corrosion loss and costs for corrosion control.

316. UNRUH, E. W. Converting Crude Lines to Products Service. Petrol. Eng., vol. 23, No. 8, Reference Annual 1951, pp. D3, 5-9.

Cost comparison of the following: (1) Reclaiming and relaying pipe versus new line, (2) operating costs reclaimed versus new, (3) reconditioning oil pipeline versus new line, and (4) operating costs recondition pipe versus new.

317. _____. Here Are Some Constructive Economics on Conversion of Crude-Oil Lines to Refined-Products Service. Oil Gas Jour. vol. 50, No. 28, Nov. 15, 1951, pp. 144-6, 150, 155-6.

Includes essentially the same information as reference 316.

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318. VAN NOY, C. W., DUNVILLE, T. C., DRESSLER, R. G., and CHAFFEE, C. C. Guide for Making Cost Estimates for Chemical-Type Operations. Bureau of Mines Rept. of Investigations 4534, 1949, 64 pp.

Concerned mainly with operating cost estimates and designed for use principally in chemical operations such as synthetic liquid fuels, anhydrous ammonia, and other process of similar nature. Goes into great detail in explaining the method and items involved.

319. VEDDER, W. O. Filters Aid At-Source Control of Dust. Chem. Eng., vol. 58, No. 5, May 1951, pp. 140-4.

Investment costs per square foot of area given for industrial, air-conditioning, and ultra-fine dust filters.

320. WADE, H. N. Removal of Nitrogen From Natural Gas. Mines Mag. (Colo.), vol. 38, No. 12, December 1948, pp. 65-6, 77.

Estimated investment and operating costs for removal of nitrogen from natural gas.

321. WAGGAMAN, W. H., and BELL, R. E. Western Phosphates, Comparison of Sulfuric Acid and Thermal Reduction Processing. Ind. Eng. Chem., vol. 42, No. 2, February 1950, pp. 276-86.

A comprehensive economic study of producing concentrated phosphates from Western phosphates. The sulfuric acid, or wet process, is favored for producing crude phosphoric acid and triple superphosphate; however, the thermal reduction produces pure phosphoric acid and chemical-grade phosphate salts more economically than the former. Of the two modifications of the thermal reduction method, the electric furnace process is more economical than the blast furnace process where the electrical energy is available at low cost.

322. WARREN, R. F. A Commodity Survey - Ethyl Chloride. Chem. Eng., vol. 58, No. 5, May 1951, pp. 319-20.

Economic and production survey for ethyl chloride.

323. _____. Hydrogenation Yields Fatty Alcohols. Chem. Eng., vol. 58, No. 6, June 1951, pp. 117-9.

First United States plant employing De Nora process for high-pressure hydrogenation of fats and fatty acids described and costs included.

324. WEATHERLY, D. M. Chamber Acid Costs. Chem. Eng., vol. 57, No. 6, June 1950, p. 212.

Comments on J. A. Barr's article on sulfuric acid manufacture (reference 11) that the contact plant may possibly produce acid more cheaply than the Mills-Packard plant when rated capacity is 125 tons or more per day of 100 percent acid.

325. WEBER, GEORGE. Fluid Hydroforming. Oil Gas Jour., vol. 50, No. 6, June 14, 1951, pp. 53-4.

Compares investment, utilities, and catalyst costs for fixed-bed and fluid hydroforming processes.

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326. WEBER, GEORGE. New Arosorb Process. Oil Gas Jour. vol. 50, No. 11, July 19, 1951, pp. 58-9.

Estimated costs of Arosorb process are:

Capacity, barrels per day of aromatics	1,000	2,000
Investment cost (thousands of dollars)	$1,200	$1,900
Operating cost per gallon of aromatics	$0.065	$0.05

327. _____. Packaged Cracker, Small T.C.C. Unit, Prefabricated and Hung in a Derrick, Will Reduce Installation Costs for Smaller Refineries. Oil Gas Jour. vol. 49, No. 7, p. 158, June 22, 1950.

A 3,000-barrel-per-day, self-contained T.C.C. unit can be installed for an estimated $1,000,000.

328. _____. Old Dutch Refining Co. Finds Platforming Process Ideally Suited To Its Needs. Oil Gas Jour., vol. 48, No. 48, Apr. 6, 1950, pp. 62-5, and 89.

Includes brief comment on investment and catalyst costs.

329. WELLS, A. J., and SINGER, S. A. G. Predesign Cost Estimates. Ind. Eng. Chem., vol. 43, No. 10, October 1951, pp. 2309-11.

General discussion of predesign cost estimates. Defines what they are and describes several types. Graphs show relationship between (1) plant investment at cost and maintenance material annual cost and (2) plant investment at current construction cost and maintenance material annual cost.

330. WHEELER, R. T. Water-Treating Plants for Secondary Recovery and Waste Disposal. Pt. 1, Oil Gas Jour., vol. 51, No. 7, June 23, 1952, pp. 95-96; Pt. 2, Oil Gas Jour., vol. 51, No. 8, June 30, 1952, pp. 66-69.

Part 1 - Methods of design for brine treatment for well injection and includes installation and treatment costs. Part 2 - Investment and operating costs for water-treating plants.

331. WHITESIDE, F. C. Economic Sizing of Oil Pipe Lines. Petrol. Eng., vol. 21, No. 7, Reference Annual 1949, pp. D3, 5-8.

Operating and investment costs involved in selecting the economical pipeline for the particular job.

332. WILLIAMS, C. R., and SUTHERLAND, R. E. Production of Aromatics From Natural Gas Liquids. Oil Gas Jour., vol. 50, No. 14, Aug. 9, 1951, pp. 84, 88, 101.

The economics of benzene production by Platforming a light natural gasoline on the basis of 5,700 barrels per stream day of debutanized light natural gasoline and 1,000 barrels per stream day of platformer feed. Benzene-extraction used in conjunction with platforming.

333. WILLIAMS, ROGER, Jr. Benzene From Petroleum - At What Price? Chem. Eng. vol. 59, No. 5, May 1952, pp. 157, 378.

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Contains the same cost information as reference 332, but in addition it has a table, that gives costs calculated for a chemical industry with an annual production of 4,200,000 gallons and another table with profits expressed as return on investment at current tax rates - 45 cents price.

334. WILSON, R. P. Cost Estimation, A Method. Chem. Eng., vol. 58, No. 12, December 1951, pp. 324-6.

A method for cost estimation.

335. _____. Cost Estimating for Refineries. Petrol. Eng., vol. 23, No. 11, October 1951, pp. C39-40, 42.

Reports the accuracy to be expected together with the data needed and the techniques used to prepare an actual cost estimate. Includes a sample cost estimate sheet.

336. _____. Techniques of Cost Estimating for Oil Refineries. Oil Gas Jour., vol. 50, No. 23, Oct. 11, 1951, pp. 116, 118, 120.

Includes essentially the same information as reference 335, except the sample cost estimate sheet is omitted.

337. WOOLFENDEN, L. B., and THIEDE, R. C. Designing for Maintenance. Chem. Eng. Prog., vol. 48, No. 3, March 1952, pp. 115-7.

Maintenance costs may be reduced by consideration of maintenance problems before design and/or selection of equipment. Shows relationship between investment and maintenance costs.

338. WORLD PETROLEUM. Old Dutch Platforming Unit Completes Second Run. Catalyst Life Greater Than Expected, vol. 22, February 1951, pp. 35-7.

Cost estimates given for 500, 1,500, 5,000, and 10,000 barrels per day platforming units.

339. WRIGHT, R. E. Materials Handling Cost May be Reduced If the Sizes for Process Pipe Lines Are Computed to Approach An Economic Optimum. Ind. Eng. Chem., vol. 42, No. 10, October 1950, pp. 87A-8A.

Formulas and examples to mathematically determine the most economical pipe sizes for process pipelines.

340. ZABEL, H. W. Metallic Sodium, Its Production and Use. Chem. Ind., vol. 65, No. 5, November 1949, pp. 714-6.

Estimated sodium metal manufacturing costs.

341. ZANDONA, O. J., and RIPPIE, C. W. Electrolytic Regeneration of Treating Solutions Provides Low-Cost Removal of Sulfur Compounds From Motor Fuels. Oil Gas Jour., vol. 51, No. 4, June 2, 1952, pp. 80, 82-4.

Discusses removal of sulfur from motor fuel. Operating data and cost comparison of utilities for steam regenerative versus electrolytic regenerative plants.

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342. ZIMMERMAN, O. T., and LAVINE, I. Chemical Engineering Costs. Industrial Research Service, Dover, N. H., 1950, 419 pp.

First chapter in the book thoroughly discusses the various types of costs that concern chemical engineering and the subsequent chapters are devoted to a detailed discussion of costs pertaining to a particular type of chemical engineering plant and/or processing equipment. The text is supplemented quarterly, as described in reference 343.

343. _____. Chemical Engineering Costs Supplement. Industrial Research Service, Dover, N. H., vol. 1, No. 1, January 1951, 16 pp.; vol. 1, No. 2, April 1951, 32 pp.; vol. 1, No. 3, July 1951, 48 pp.; vol. 1, No. 4, October 1951, 68 pp.

These publications supplement the text Chemical Engineering Costs, reference 342. These include Changes in Cost section, which gives a current labor and material cost index, and similar detailed discussion of costs for other types of equipment not previously covered in the basic text or preceding supplements. Supplements also show changes in cost of previously mentioned items.

344. _____. Chemical Engineering Costs Quarterly. Vol. 2, No. 1, January 1952, 19 pp.; vol. 2, No. 2, April 1952, 47 pp.

These supplements continue the series described in reference 343 and contain information of essentially the same nature.

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